Nature of Local Benefits to Communities Impacted by Sour Gas Development

Public Safety and Sour Gas Recommendation 79

Final Report

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Prepared by

I-79 Stakeholder Steering Committee

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Executive Summary

In January 2000, the Alberta Energy and Utilities Board (EUB) formed the multistakeholder Provincial Advisory Committee (Advisory Committee) on Public Safety and Sour Gas (PS&SG) to review the regulatory system for sour gas as it relates to public health and safety.

In December 2000, the Advisory Committee issued its *Findings and Recommendations Final Report* to the EUB. The report contained 87 recommendations directed toward

- a better understanding of sour gas,
- improving the sour gas regulatory system,
- reducing the impacts of sour gas on public health and safety, and
- improving the consultation that takes place with the public on all sour gas matters.

Seven of the recommendations are directed at improving consultation with the public on sour gas matters. In the preamble to these recommendations, the Advisory Committee stated

> The [public] consultation process often involves information respecting the benefits of sour gas development. Concerns were raised that suggested that many of the benefits accrue to the province as a whole and that the local or regional share of those benefits does not justify the risks or other negative impacts.

One of the seven recommendations, Recommendation 79, which is the focus of this report, reads as follows:

> The EUB initiate a study involving industry, government, the public, and municipal representatives to determine the nature of local benefits, such as reduced property taxes and local business opportunities, to communities impacted by sour gas development.

The steering committee formed to complete the study adopted the following wording for its mandate based on its interpretation of Recommendation 79:

> The Steering Committee for Recommendation 79 will complete a study involving industry, government, the public and municipal representatives to determine the nature of net financial benefits to communities impacted by sour gas development.

Consistent with the recommendation, the steering committee for Recommendation 79 (Initiative 79, or I-79) was a multistakeholder committee (the I-79 Committee, or Committee) that included representation from municipal government, the academic community, industry associations, the public at large, relevant provincial government departments, and EUB staff. EUB Economics Group personnel coordinated the data collection and performed the economic analysis required for the Committee's work. The I-79 Committee's role was to

- identify matters of importance to particular stakeholders with respect to the study,
- provide direction with respect to the scope of work,
- facilitate the gathering of information needed for the study,

- provide discussion and feedback on the study's findings throughout the course of the study, and
- prepare the final report of findings.

It was important to the I-79 Committee members that the study identify the benefit of sour gas development to communities and also recognize local impacts caused by its presence. The Committee decided that financial benefit should be reported on a net basis (less costs) when corresponding cost data could be quantified. For costs that could not be easily quantified, the Committee decided to use an interview process to gather qualitative information about the impact on residents.

For practical purposes, the "communities" studied needed to be large enough that expenditure and financial data would be readily available. The Committee concluded that the analysis of benefits should be conducted at the municipal level. The study focused on four municipalities located in sour gas producing regions of Alberta: Municipal District of Rocky View, Municipal District of Foothills, Clearwater County, and Saddle Hills County. These were chosen because of their different characteristics (i.e., total population, economic base, and the extent of rural versus urban population) to provide a cross-section of municipalities in the province where sour gas production occurs.

The study examined three key areas relevant to the determination of benefits:

- Economic Benefit – the employment, income, and secondary job creation generated by the upstream component of sour gas development in the four municipalities and in the province of Alberta
- Net Financial Benefit to Municipalities – the difference between the revenues and expenditures attributed to the presence of sour gas development in each of the four municipalities
- Impact of Sour Gas Development on Local Residents – identification in a qualitative manner of the impacts experienced by residents and landowners most affected by sour gas development

The study's findings based on sour gas activity and economic data for the year 2000 are summarized as follows:

Economic Benefit

- The sour gas industry contributes significantly to the Alberta provincial economy. Throughout the province, the sour gas industry supported over 37 000 jobs (direct plus spin-off) and generated approximately $1.3 billion in wages and salaries. The sour gas industry also has a fiscal impact on the province through natural gas royalties, income taxes, and indirect taxes. The royalty collected on natural gas, natural gas liquids and sulphur from sour gas production in the year 2000 was $1.52 billion, the freehold mineral tax collected from sour gas production was $41 million, and sour gas activities (direct plus spin-off) generated $225 million in provincial taxes.
- In the four municipalities studied, activities associated with seismic, drilling, production, and processing of sour gas accounted for 930 jobs (direct plus spin-off)

and generated approximately $50 million in wages and salaries. The employment impact in each municipality was estimated at 280 jobs in Rocky View and Foothills, 550 jobs in Clearwater County, and 100 jobs in Saddle Hills County. Labour income associated with this employment was estimated to be $15 million in Rocky View and Foothills, $30 million in Clearwater County, and $6 million in Saddle Hills County.

- The number of business opportunities created from sour gas development in a municipality depends on the ability of the local economy to provide services and materials required by the sour gas industry. The extent to which local labour and businesses were able to capture these expenditures varied among the municipalities; however, on average, about 20 per cent of the expenditures remained in the local economy. In terms of increased output, local businesses providing goods and services in construction and maintenance, professional and technical services, transportation, wholesale and retail trade, and business/personal services were best able to capture the spending associated with sour gas activities.

- The Committee did not have quantitative information to analyze the impact of sour gas development on the local economies of First Nations communities. However, through the interview process, the Committee was made aware that there is an expectation by First Nations that sour gas development near their communities should create more employment opportunities for their people than they currently experience.

- Lease payments (wells and pipelines) combined with payments by seismic companies to landowners total an estimated $20 million for the four municipalities.

- Some producers active in the sour gas industry within the municipalities provide direct corporate support to charitable organizations and community projects through financial contributions and employees active in volunteer roles. This support is appreciated within the community and is acknowledged as an important local benefit.

Municipal Net Financial Benefit

- Sour gas activities and the spin-off economic activity that is created generate roughly $60 million in gross revenues for the over 50 municipalities in which the sour gas industry operates. In each of the four municipalities studied, the revenues generated through taxation of the sour gas industry exceeded the incremental costs borne by the municipality to support the presence of the industry. The financial net benefit for the year 2000 was calculated to be $1.3 million for Rocky View, $0.5 million for Foothills, $3.8 million for Clearwater County, and $1.6 million for Saddle Hills County.

- The revenues received by a municipality from the sour gas industry have an impact on the residential mill rate in each municipality. It was estimated that without the financial contributions of the sour gas industry, the mill rate in each of the four municipalities would rise by the following amounts: Rocky View, 12 per cent, Foothills, 6 per cent, Clearwater, 55 per cent, and Saddle Hills, 33 per cent.

- Generally, the committee observed that the smaller the existing tax base of a municipality (i.e., lack of industrial activity and more sparsely distributed population), the more significant the financial impact associated with the sour gas industry. The importance of the net financial benefit is less in areas with a large

residential tax base or in municipalities that have a large commercial and industrial tax base other than the sour gas industry.

Impact of Sour Gas Development on Local Residents

- The sour gas industry generates economic benefits for the province and for municipalities, which are shared among residents. However, as the sour gas industry grows and as population centres expand, an increasing number of people are now faced with sour gas development in their communities. Some residents who live near sour gas facilities have concerns about the industry with respect to safety, health, the environment, lifestyle, and the time commitment required to deal with sour gas issues. In their view, these concerns must be balanced against the economic benefit that sour gas development generates.

- Increased certainty about the impacts of sour gas development would allow residents to better evaluate the impacts of sour gas development. There have been a number of research studies conducted in Alberta that have examined such topics as acid deposition and livestock health; nonetheless, some residents interviewed within the four municipalities requested that further scientific work be conducted into the long-term impacts of sour gas operations on water, air, and soil quality. Additionally, a number of residents requested that more studies be conducted into the human and animal health effects of prolonged exposure to low levels of sour gas emissions.

- When meaningful consultation occurs between sour gas operators and local residents in the predevelopment stage of a project, an effective working relationship is usually developed. Residents interviewed in the four municipalities want to be informed regarding operations in their area and expect sour gas operators to conduct their operations in a manner that protects the residents' safety.

- The residents interviewed also indicated they expect the sour gas industry to be accountable for their operations and the actions of their employees and contractors. Failure on industry's part to communicate with residents or to take responsibility for operating problems destroys trust between industry and residents and leads to conflict. In some instances industry and the community have come together to form a synergy group in order to create a better understanding of industry and community issues and to help resolve conflicts that may arise from industry and public interaction. A successful synergy group can play a significant role in reducing tension between community and industry.

Concluding Remarks

This study has shown that sour gas activities generate benefits for the province and also for the municipalities where they operate. Regardless of where one lives in the province, all Albertans enjoy some share of the provincial benefit. Albertans living in an area where the sour gas industry operates may also receive a share of the local benefits generated, perhaps directly through employment or business income or indirectly through the net financial benefit accruing to the municipal government. Nevertheless, some people argue that those who live near sour gas operations experience costs and are negatively impacted in ways others are not, and suggest that these impacts are not adequately offset by the their share of the benefits.

The I-79 Committee's study provides a detailed quantification of local benefits at the municipal level for individuals to consider within the context of their own circumstances. It does not provide a full accounting of costs or negative impacts that may be experienced by some individuals and therefore does not attempt to balance benefits and costs on behalf of all affected by sour gas development. Nevertheless, the I-79 Committee notes that many of the recommendations made to the EUB by the Advisory Committee are directed at the same key areas of concern raised during this study. It is anticipated other recommendations may increase the level of understanding and certainty about health and safety issues, will explore equitable solutions to impacts such as sour gas setbacks, and will increase the level of confidence that people have in the sour gas industry and its regulation.

1 Introduction

In January 2000, the Alberta Energy and Utilities Board (EUB) formed the multistakeholder Provincial Advisory Committee (Advisory Committee) on Public Safety and Sour Gas (PS&SG) to review the regulatory system for sour gas as it relates to public health and safety.

In December 2000, the Advisory Committee issued its *Findings and Recommendations Final Report* to the EUB. The report contained 87 recommendations directed toward

- a better understanding of sour gas,
- improving the sour gas regulatory system,
- reducing the impacts of sour gas on public health and safety, and
- improving the consultation that takes place with the public on all sour gas matters.

Recommendation 79 was one of seven recommendations that the Advisory Committee directed at improving consultation with the public on sour gas matters. Recommendation 79, which is the focus of this report, reads as follows:

> The EUB initiate a study involving industry, government, the public, and municipal representatives to determine the nature of local benefits, such as reduced property taxes and local business opportunities, to communities impacted by sour gas development.

This report presents the findings of a multistakeholder committee established by the EUB to undertake the study. The methodology, analysis, findings, and conclusions of this study are those of the I-79 Committee.

As "benefit" was defined by the Committee to broadly mean economic impacts (the effect on jobs, wages, business opportunities, taxes), the terms "economic benefit" and "economic impact" are used interchangeably throughout the report.

2 Background

Alberta is a key natural gas producer in North America, with over 80 000 producing natural gas wells and over 700 natural gas processing plants. Alberta's current annual production is about 140 billion cubic metres (10^9 m^3) of marketable natural gas. The natural gas industry in Alberta is a key economic contributor to the provincial economy, with total sales of natural gas and natural gas liquids (NGL) valued at $34 billion in 2001.

Natural gas is the primary heating fuel for most Alberta homes and is also used to produce electricity in the province. The natural gas industry supplies fuel and feedstock to industrial users, including Alberta's petrochemical industry, which on its own employs over 6400 people and generates roughly $8 billion in total sales.

About 30 per cent of all natural gas produced in Alberta contains hydrogen sulphide (H_2S) and is commonly referred to as "sour" gas. H_2S is highly toxic at low concentrations and must be removed from the gas through processing. Exploration for and production of sour gas requires special emergency preparedness planning, equipment, and stringent safety requirements for industry personnel and the public who live near sour

gas facilities. Because the sour gas industry is spread across much of Alberta, wells and other facilities frequently exist in inhabited rural areas and sometimes in close proximity to major population centres. Some people living near sour gas operations view the industry negatively. They are concerned about the risk of an uncontrolled release of sour gas, the unknown health effects of exposure to low-level emissions, and the potential degradation of local air and water quality.

The Advisory Committee, through its provincewide consultation sessions, understood that these important issues needed to be addressed. Several of the 87 recommendations proposed by the Advisory Committee were directed towards improved understanding of the effects of sour gas on human health. Others relate to improving emergency preparedness and monitoring for sour gas contaminants in the air. Recommendation 79 was advanced by the Advisory Committee to quantify economic benefits that could accrue to local communities as a result of sour gas development. It was the Advisory Committee' s intention that a study to measure such benefits could lead to a better understanding and improved consultation between industry and the public.

There is no dispute that financial benefits accrue at the provincial level from sour gas resource development. However, the extent to which financial benefits are realized in communities where sour gas is produced is not well understood. Some residents believe there is little benefit and that any negative impacts from sour gas development are borne by communities where the development occurs. This sentiment was expressed to the Advisory Committee throughout its public outreach sessions. There is a perceived imbalance between the positive impacts that accrue at the provincial level and the negative impacts that occur at the local level. This perceived imbalance explains the resistance to the sour gas industry in some communities.

3 Recommendation 79 Study

This section describes the process put in place to undertake the study; it outlines the study's scope and explains the methodology used to conduct an analysis of benefits.

3.1 Process

The work on Recommendation 79 (Initiative 79, or I-79) was undertaken by a multistakeholder steering committee (the I-79 Committee, or Committee) formed to guide the study process. In keeping with the recommendation, the I-79 Committee included representation from municipal governments, the academic community, industry associations, the public at large, relevant provincial government departments, and EUB staff. Several attempts were made through the Indian Resource Council to obtain First Nations participation on the Committee. As these efforts were unsuccessful, no representative from the First Nations participated in Committee meetings. A list of the I-79 Committee members is provided in Appendix 1. The Committee's role was to

- identify matters of importance to particular stakeholders with respect to the study,
- provide direction with respect to the scope of work,
- facilitate the gathering of information needed for the study,
- provide discussion and feedback on the study's findings throughout the course of the study, and
- prepare the final report of findings.

An independent consultant was retained by the EUB to lead the I-79 Committee process, organize and facilitate meetings, and assist in preparing the final report. EUB Economics Group personnel coordinated data collection and performed the required economic analyses.

The I-79 Committee came together on a regular basis, meeting twice a month in the early stages of the study and monthly or bi-monthly throughout the study's progress. In all, the I-79 Committee met on eleven occasions over an 18-month period.

The first step taken by the I-79 Committee was to interpret the intent of Recommendation 79, its objectives and expected results. An issue of critical importance to the I-79 Committee members was that the study not only identify the benefit of sour gas development to communities, but also recognize local impacts caused by its presence. The Committee concluded that economic benefit to a municipality could indeed be overstated without consideration of identifiable costs to a municipality caused by the presence of the sour gas industry. Where these local costs could be quantified, they have been included in the analysis to determine a "net financial benefit" to the municipality. To that end, the I-79 Committee adopted the following wording change to Recommendation 79:

> The Steering Committee for Recommendation 79 will complete a study involving industry, government, the public and municipal representatives to determine the nature of net financial benefits to communities impacted by sour gas development.

The I-79 Committee understood that the intent of the Advisory Committee's recommendation was to analyze and determine the nature of local benefits of sour gas development. This study describes the types of local benefits that can be expected from sour gas development in an area and uses a widely accepted economic analysis method (input-output analysis) to quantify these local benefits. The analysis was conducted for four municipalities in Alberta based on sour gas development activity within their boundaries during the year 2000.

The I-79 analysis did not attempt to quantitatively consider negative impacts that may be experienced by individuals or small communities affected by sour gas operations. A significant limitation to doing this is that many of the key impacts identified by affected parties, such as health and safety concerns, air and water quality concerns, potential land-use restrictions, and quality-of-life issues, are dependent upon individual values and opinions, as well as site-specific circumstances, and therefore inherently difficult to quantify. Also, since residents of a municipality experience these impacts to varying degrees, it would be difficult to aggregate these costs in a meaningful way to allow comparison to municipal economic benefit. An analysis of broader social benefits and costs is a valid approach, but is only practical when positive and negative impacts can be readily quantified and compared by assigning a dollar value to each with reasonable certainty. The Committee notes that there is ongoing research to develop a system that integrates environmental and economic accounting, whereby physical and monetary values of the environment are integrated with economic production data. The idea was put forward by the United Nations as a way to monitor sustainable development. However, there is still much debate over the method of measuring environmental impacts (for example, resource depletion and pollution) and linking them to current methods of measuring economic growth. The expectation is that while this research may help over the longer term to quantify the impacts of sour gas development at a national or

provincial level, even if this research were more developed, it would still be difficult to quantify the impacts at a community or individual level.

Notwithstanding the difficulty of incorporating the costs of all impacts in the analysis, the I-79 Committee strove to provide an appropriate balance by including a qualitative discussion of a number of negative impacts without assigning a cost to them. In doing so, the I-79 Committee acknowledges that the impacts are important issues for those affected by sour gas development.

During the course of the I-79 study, the Advisory Committee was briefed twice on the study's progress. The Advisory Committee indicated that it agreed with the approach to determine a net financial benefit to municipalities. However, it requested that the net financial benefit also account for the cost of sour gas setbacks (where land development opportunity is restricted because of sour gas facilities). The I-79 Committee considered this request but concluded that while the costs of foregone land development opportunities are likely quantifiable in site-specific cases, the I-79 study, with a focus on one year, would not provide the appropriate context to examine this impact. The I-79 Committee believes the setback issue could be more appropriately dealt with in a study that examines the impact of setbacks over an extended period of time. It was concluded that the setback issue warrants its own study that involves the relevant stakeholders. Since Recommendation 53, as originally proposed by the Advisory Committee, is to deal with the implications of setbacks and the ability to develop property, it was determined that the setback issue would more appropriately be dealt with in that context.

At the time of writing, the I-79 Committee understands that Recommendation 53 has yet to commence, due to the fact that Recommendation 17, Protocol for Estimating Risk from Sour Wells and Pipelines, is not yet complete.[1] The thinking was that Recommendation 17 must be complete before substantive work could begin on Recommendation 52,[2] which in turn is tied to Recommendation 53. Due to the longer timeline required for these recommendations and the Advisory Committee's desire to proceed with Recommendation 53, it is now expected that work will be initiated on Recommendation 53 prior to completion of Recommendations 17 and 52. This was determined in recognition of the fact that methodology selection and preliminary analysis could proceed prior to completion of the other two initiatives. Recommendation 53 will commence with the EUB developing a proposed terms of reference and project scope document for discussion. Following this, a stakeholder committee will be engaged (likely by late fall or early winter 2003) to steer, guide, and participate in the study. Additional information on the implementation of Recommendation 53 will be provided in the next update to the Advisory Committee, expected to be released in October 2003.

3.2 Scope

The sour gas industry involves numerous activities, from predrilling exploration, drilling, and completion of wells to construction of gathering pipelines, field production facilities, and gas processing plants (activities commonly referred to as upstream). Large gas transmission pipelines, other industries that further process natural gas, and ultimately the

[1] Recommendation 17: The EUB, in cooperation with stakeholders, develop a framework and methodology for standardizing dispersion modeling and probabilistic risk assessment that will provide clarity to the industry and the public.

[2] Recommendation 52: Once the framework and methodology for dispersion modeling and probabilistic risk assessment methodology have been developed (Recommendation 17), the EUB use them as the basis for a review of the current criteria for sour gas setbacks.

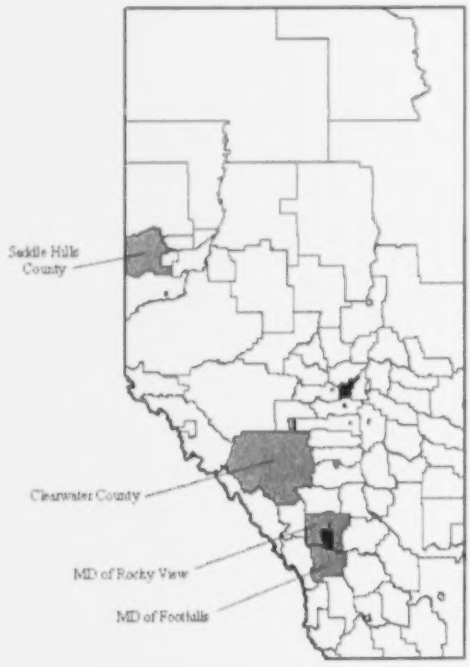
end users of natural gas constitute the downstream segment of the industry. As the focus of this study is on sour gas development at a local level, only expenditures made in the upstream component were included. Any forward linkages that sour gas production may have to other industries, such as Alberta's petrochemical industry, which is a downstream user of natural gas and its by-products, were excluded from the analysis.

In addition, the Committee determined that the quantification of economic benefit would focus on the annual expenditures associated with finding, producing, and processing sour gas. The Committee recognized that there is also economic benefit associated with construction activities, as new investments are made to either expand or add sour gas facilities in the province. However, as new construction would not occur every year, the impact would be short lived (only lasting as long as the construction activity). Construction activities associated with exploration and drilling are also generally short lived; however, these activities recur more regularly, while the resource in an area is developed and therefore have been included in the analysis.

An important step in establishing the scope and methodology for the study was to determine the definition of a community to be studied. For practical purposes, the "communities" studied needed to be large enough that expenditure and financial data would be readily available. The Committee concluded that the analysis of benefits should be conducted at the municipal level, realizing that individuals or small communities within a municipality would have different experiences depending on the extent of interaction with the sour gas industry in their area. While these differences could not be captured in the economic analysis, they are addressed in a qualitative manner.

There are roughly 50 municipalities with sour gas production in Alberta. The number of plants in a municipality ranged from one to as many as 16, averaging 6 per municipality. In 2000, about 200 sour gas plants in Alberta had marketable natural gas production. To study each of the 50 municipalities and collect information on more than 200 sour gas plants was not possible. Instead, the Committee chose a case study approach, whereby municipalities were selected with different characteristics (i.e., total population, economic base, and the extent of rural versus urban population), to provide a cross-section. The 4 selected for study were Municipal District (MD) of Rocky View (Rocky View), MD of

Figure 1: Location of Municipalities Studied



Foothills (Foothills), Clearwater County, and Saddle Hills County (see Figure 1). The I-79 Committee determined that consideration should also be given to economic benefit measured for the province as a whole.

The I-79 Committee identified a number of local benefits and costs that it attributed to sour gas operations (see Appendix 2). Benefits included employment opportunities, income, and tax revenues, as well as indirect impacts, such as improved roads, expanded services, and reduced property taxes. Costs included increased municipal expenditures, reduced land-use opportunities, increased traffic, pollution, safety concerns, and other social and community impacts. Some negative impacts, such as increased costs for emergency preparedness and increased road maintenance, are quantifiable at the municipal level. Others either could not be readily quantified or their measurement was not consistent with the methodology used, so they were not included in the net financial benefit determination.

3.3 Methodology

The methodology adopted has three components:

1) quantifying the economic benefit in terms of employment, income, and secondary job creation generated by sour gas development in Alberta and in the four municipalities using input-output impact analysis;

2) estimating the revenues and expenditures that can be attributed to the presence of sour gas development in order to calculate the net financial benefit in each municipality; and

3) identifying the impacts experienced by residents and landowners affected by sour gas development.

The methodology for each step is described in the three sections that follow. For a detailed discussion of the methodology, analysis, and assumptions, see Appendices 3, 4, and 5.

3.3.1 Economic Benefit Calculation

The economic benefit to a municipality associated with sour gas activity can be measured in terms of employment, wages and salaries, and taxes, as well as the business opportunities resulting from the multiplier or spin-off impacts associated with this activity. The extent to which these benefits remain in a municipality ultimately depend on the extent that goods, services, and labour purchases by the sour gas industry originate from within the local economy. A diverse local economy has more capacity to capture the spending, generating a greater local impact. Accordingly, the municipalities in sour gas regions of the province were purposely selected to provide a contrast in terms of population densities, proximity to rural/urban centres, and economic base profiles.

To measure economic benefit, the study used the input-output (IO) analysis technique. IO models reflect the interlinkages among the different sectors of the economy, depicting how these sectors interact with one another in the production and consumption of goods and services. An IO analysis makes it possible to trace the impacts of expenditures by the sour gas industry as the spending works its way through other industry sectors operating in the municipality. An IO model measures the impact of the sour gas industry activity

and the corresponding rounds of industry output in other sectors (spin-off impacts) that combine to expand the local economy.

This technique is well developed, widely accepted, and provides a detailed view of the impacts an industry has on the level of economic activity within an economy to provide a "snapshot" of how industries interact with each other at a specific point in time. The analysis for this study was based on the year 2000, the most recent year for which all necessary data were available.

To conduct the IO analysis, the following information was needed for seismic, drilling, and sour gas processing activity in the province and in each of the four municipalities:

- the total number of people employed by sour gas activities within the municipality and the expenditures on wages and salaries;[3]
- the type and dollar amount of expenditures on goods and services for each of the sour gas-related activities; and
- an indication of where the labour, goods, and services are sourced—whether from within the municipality, from the remainder of the province, or from outside the province.[4]

Seismic expenditure data were obtained from published expenditure totals for the province[5] and apportioned by municipality based on drilling records (wells spudded in 2001) obtained from the EUB. Drilling expenditure data were estimated by obtaining a drilled-well count for the municipalities and for the province from EUB records and using published well cost studies to obtain an average cost per metre, which was used to calculate an expenditure estimate.[6] In both cases, an indication of the extent to which expenditures (type and amount) remained in a municipality was obtained through discussions with the respective industry associations (Canadian Association of Geophysical Contractors and Canadian Association of Oilwell Drilling Contractors).

Data on sour gas processing expenditures were obtained by surveying each of the natural gas producers operating sour gas facilities in the four municipalities. In total, there were 23 sour gas plants, but information was received from only 17, or 74 per cent. Responses were considered confidential, and to protect the confidentiality of the data, plant-specific information was averaged over a minimum of 5 plants (no single-plant information is reported in this study). To do this, it was necessary to combine the plant data for Rocky View and Foothills and to report the two municipalities as one region. Provincial sour gas processing expenditure data were estimated using the average expenditure data for the 17

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[3] There may be residents in the municipalities studied who are employed in the sour gas industry but working outside the municipality. In this case the municipality is benefiting in terms of employment in the sour gas industry but this is not counted because the residents work outside the municipality. Hence, the municipal impacts are somewhat understated.

[4] For the IO analysis, municipality is defined to include the towns and villages located within the municipal district or county boundaries. This was necessary because the local purchase and employment information provided by the processing plant personnel surveyed included both rural and urban areas (excluding cities) within the municipal boundaries.

[5] Canadian Association of Petroleum Producers, *Statistical Handbook for Canada's Upstream Petroleum Industry*, 2000 and 2001.

[6] Petroleum Service Association of Canada, *Well Cost Study*, 1997-2003.

plants and adjusting it based on published average unit operating cost rates (UOCR) to account for differences in the sour gas plant types.[7]

In total, data were collected for 12 custom IO model runs to measure the economic impact of each of the three sour gas activities (seismic, drilling, and sour gas processing) in the three municipal areas (Rocky View/Foothills, and Clearwater County, Saddle Hills County) and for Alberta as a whole. The IO results were obtained using the 1998 Input-Output Impact Model maintained by the Statistics Branch of Alberta Finance. The 1998 IO model, which was released in November 2002, is the latest available.

3.3.2 Municipal Net Financial Benefit

Municipalities collect tax revenues on sour gas facilities. If this revenue is greater than the cost to the municipality to accommodate sour gas development, the municipality receives a net financial benefit. The size of this benefit, in turn, affects the amount of tax revenues a municipality must raise from residential and commercial assessment to meet its revenue requirements.

To estimate the municipal net financial benefit, information was collected from the four municipalities that described the

- proportion of sour gas tax revenue to total revenue,
- proportion of sour gas municipal expenditures to total municipal expenditures,
- relative size and importance of net revenue from sour gas facilities, and
- impact on the municipal budget if the sour gas industry were not present and the hypothetical impact on residential tax rates.[8]

Calculating the net financial benefit for each municipality required an estimate of the municipal tax revenue that can be attributed to sour gas, as well as an estimate of the costs incurred by the municipalities associated with the presence of sour gas development. The difference between the two estimates provides an estimate of the net financial benefit to the municipality.

The municipalities were contacted directly for specific information on assessment data for the year 2000 and revenue and cost data for the year 2001.[9] Linear assessment (assessment on subsurface facilities) information was obtained from Alberta Municipal Affairs.

To estimate municipal revenues attributable to sour gas, it was necessary to isolate the assessment associated with sour gas facilities and the applicable tax rates. Nonresidential assessment is broken down into essentially three categories at the municipal level:

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[7] Alberta Energy, Designated and Plant Type Unit Operating Cost Rates, 2000. There are three sour gas plant types defined by Alberta Energy: Type 3 is dry gas with sulphur removal, Type 4 is wet gas with sulphur removal, and Type 5 is dry/wet gas with sulphur recovery.

[8] For the municipal net financial benefit calculation, municipality is defined as the area that falls under the jurisdiction of the municipal district or county (does not include the towns and villages). Revenue and cost data were only collected for the four municipal jurisdictions due to the difficulty in obtaining a sour gas share of revenues and costs for each municipal jurisdiction. This narrower definition (than the one used in the economic benefit calculation) captures most of the municipal net benefit, as the sour gas facilities are primarily located in the rural areas rather than in the towns and villages.

[9] Sour gas activity and assessment values in 2000 are the basis for the calculation of tax revenues in 2001.

machinery and equipment, buildings and structures, and linear (includes assessment of nonsurface facilities, such as wells and pipelines). Together, these capture almost all of the revenue obtained from sour gas facilities.

Municipal costs attributable to sour gas are primarily incurred in two areas: 1) the time and work required for the review of emergency response plans and site inspections, and 2) additional expenditures on road construction, upgrades, and maintenance. Road maintenance is an operating cost, while road construction and upgrading are capital costs; therefore, sour gas costs have both an operating and a capital component.

The municipal assessors were asked to provide an estimate of the assessment value associated with sour gas facilities and for detailed information on municipal tax rates. Information on sour-gas related expenditures was obtained from municipal representatives within the relevant departments. For example, transportation personnel were contacted to obtain road cost data, while those responsible for emergency planning administration were contacted to obtain the expenditures incurred for emergency response plan review and site inspections. In addition, to estimate municipal road costs attributable to sour gas, Alberta Transportation was consulted to obtain information about how trucking activity affects road infrastructure.

Information on total revenue, including provincial grants and total expenditure data, was obtained from 2001 year-end financial statements. This was used to compare the size of the financial impact of the sour gas industry relative to the rest of the municipal budget.

3.3.3 Impact of Sour Gas Development on Local Residents

Some residents who live close to sour gas facilities may experience costs and other impacts that are not quantified. These include matters of safety, the environment, human and animal health, and the amount of personal time spent to deal with sour gas issues. Many of these impacts are difficult to measure and cannot be generalized across individuals to enable a comparison to economic benefit measured at a municipal level. For this reason, the I-79 Committee chose to consider these impacts qualitatively.

Information was collected from a variety of sources:

Provincial Advisory Committee on Public Safety and Sour Gas – The Advisory Committee held provincewide consultations from December 1999 to December 2000, hearing from people living in sour gas areas and from those involved with sour gas in some other manner. Residents were encouraged to share their thoughts and concerns with the Advisory Committee and make submissions through public meetings and written correspondence. This information is included in the Advisory Committee's *Final Report and Recommendations* and its appendices.

Synergy Groups and Industry Surveys – Synergy, or stakeholder, groups operate throughout the province to bring together members of the energy industry, local residents, and in some cases the EUB to address issues of importance to the community with respect to sour gas development. Members of one of these synergy groups, the Sundre Petroleum Operators Group (SPOG), were interviewed for the I-79 study regarding local issues. SPOG also provided the I-79 Committee with a copy of a survey of residents that it conducted.

Some natural gas plant operators also conduct surveys among area residents to obtain feedback on their operations. A survey conducted by one gas plant operator in one of the municipalities studied was made available to the I-79 Committee for review.

Interviews Conducted Specific to the I-79 Study – Interviews were conducted with several individuals in each of the four municipalities and with members of the Oil and Gas Committee of the Stoney First Nation. Preliminary interviews were conducted with members of the Sunchild and OChiese First Nations, with the intent to follow up with a formal interview with the chiefs and band councils. A summary of the interviews is in Appendix 5.

Ms. Doreen Healy, an Aboriginal consultant working with the EUB, assisted in obtaining Aboriginal involvement in the study. Several attempts were made by Ms. Healy to arrange additional interviews with the chiefs and councils of bands located near the municipalities selected for this study; however, the bands did not agree to these interviews.

I-79 Committee Members – Members of the I-79 Committee contributed to this process by sharing their knowledge and experiences with respect to sour gas development in their communities. Many were able to provide their perspective as landowners living near sour gas facilities. The municipal representatives on the Committee also gave their perspectives as elected representatives.

The interview approach was determined to be an appropriate method for collecting the qualitative data required for this section of the study. By engaging residents in focused discussions about the sour gas industry, the I-79 Committee received first-hand information about the impacts individuals attempt to assess against the economic benefit whether at the municipal or provincial level. However, the Committee acknowledges that the number of people interviewed does not constitute a sufficient sample for statistical purposes, as such; the interview results should not be generalized across all residents in the municipalities studied.

4 Study Findings

This section summarizes the results of the economic benefit calculation for the province and the select municipalities. It also summarizes the municipal net financial benefit calculation and provides a summary of identified impacts on residents living near sour gas developments.

4.1 Economic Benefit

The economic benefit results are reported in terms of jobs, income, secondary job creation (spin-off employment), and taxes. Economic benefit is summarized first at the provincial level, and then at the municipal level. The measurement of economic benefit is based on annual expenditures for sour gas activities related to seismic, drilling, and sour gas processing. The benefit will continue as long as sour gas activity remains at the level experienced in the year 2000. With everything else equal, if sour gas activities increase, the economic benefit will also increase. Conversely, if sour gas activities decline, the benefit will also decline.

4.1.1 Provincial Economic Benefit Results

The sour gas industry makes a significant contribution to the provincial economy. In total, it supports over 37 000 jobs, with roughly 6300 directly employed in the sour gas industry and another 30 700 in service industries located throughout the province. These jobs generate about $1.3 billion in wages and salaries. Provincially, drilling activity produces the largest number of jobs, followed by sour gas processing. The provincial economic benefit (in terms of jobs and labour income) for each of the sour gas activities is provided in Table 1.

Table 1. Summary of provincial jobs and labour income results (year 2000)

	Seismic		Drilling		Sour gas processing		Total	
	# Jobs[1]	W&S $M[2]	# Jobs	W&S $M	# Jobs	W&S $M	# Jobs	W&S $M
Industry specific	1 029	68.2	3 507	338.9	1 725	169.1	6 261	576.2
Direct suppliers	564	21.2	4 521	170.0	1 624	73.3	6 709	264.5
Spin-off effects	1 171	43.4	7 770	289.0	3 155	115.9	12 096	448.3
Total	2 764	132.8	15 798	797.9	6 504	358.3	37 162	1 289.0

[1] # Jobs for seismic and drilling are expressed as a full-time equivalent (FTE).

[2] W&S $M is wages and salaries expressed in millions of dollars and includes labour income plus supplementary labour income.

Sources: Alberta Finance and EUB.

Geological and geophysical expenditures for the province totaled $824 million in 2000.[10] Seismic activity associated with sour gas was estimated at $195 million, or 24 per cent of the total. While this activity is spread throughout the province, it is more concentrated in the foothills (west) and the north. Seismic activity related to sour gas supports 2760 jobs (full-time equivalent, or FTE), of which 1030 are directly with seismic companies and the remaining 1730 is with direct suppliers to seismic companies and other service providers.

Drilling activity in 2000 included over 10 000 exploration and development natural gas wells, of which about 1500, or 15 per cent, were sour gas wells. Drilling, well completion and well tie-in activities related to sour gas support 16 000 jobs (FTE) and accounted for over 40 per cent of the total jobs related to sour gas activities in Alberta. Approximately one-fifth of the 16 000 jobs represented employees working directly for the drilling contractors. Total expenditures (including an estimated well tie-in cost) for sour gas drilling were estimated at $1.4 billion, or roughly 21 per cent of the total $6.6 billion in drilling expenditures for 2000.[11]

Total annual operating expenditures for sour gas plants (including expenditures related to plant, well, and gathering pipelines) were estimated at about $1.0 billion. When sweet gas throughput is excluded, total processing expenditures fall to $665 million. Processing activities attributed to sour gas create an estimated 1725 jobs. In addition, this activity supports another 4800 jobs in service industries.

In addition to impacts associated with employment and income, the sour gas industry has a fiscal impact on the province through natural gas royalties, freehold mineral tax, income taxes, fees, and licence payments. In 2000, the total value of natural gas, natural gas liquids and sulphur royalties collected by the province was $5.75 billion. To calculate the royalties specific to sour gas production, the higher capital and processing costs

[10] Canadian Association of Petroleum Producers, *Statistical Handbook for Canada's Upstream Petroleum Industry*, 2001.

[11] Ibid.

associated with sour gas production had to be taken into account, as well as the deep gas royalty holiday that is more prevalent with sour gas. Alberta Energy provided an estimate of the sour gas royalty. In 2000, the natural gas, natural gas liquids and sulphur royalty collected on sour gas production was estimated at $1.52 billion, or 26 per cent of the total. The freehold mineral tax collected from sour gas production was estimated at roughly $41 million in 2000.

Sour gas activities also contribute to provincial revenues through taxes. The IO model calculates the fiscal impact to the province in terms of direct taxes on business, personal income taxes, transfers to government (e.g., health-care premiums), and indirect taxes (e.g., gasoline tax, licences, and permits). Sour gas activities (including seismic, drilling, and sour gas processing) generated over $225 million in provincial (direct and indirect) taxes and almost $60 million in municipal taxes.

There are also impacts at the provincial level caused by the presence of the sour gas industry. In 2000, the sour gas industry emitted about 275 tonnes per day of sulphur to the atmosphere as sulphur dioxide through sour gas processing and well testing operations. Occasionally, small amounts of sour gas escape from wells, pipelines, or production facilities and are released to the atmosphere, which can have a transient impact on local air quality. In 37 such incidents during 2000 some 827 thousand cubic metres of sour gas was reported released. The sour gas industry is also a modest user of Alberta's fresh water during drilling operations and for sour gas processing. However, water use by the sour gas industry is small in comparison to other energy sector consumption, such as oilfield injection and oil sands processing, and in comparison to use by other major water-consuming sectors, such as irrigation and municipal use. Although the I-79 Committee did not attempt to assign a dollar value to this consumption of "environmental capacity," the Committee contends it represents a cost borne by the province in order to capture the economic benefits described above.

4.1.2 Municipal Economic Benefit Results

Total expenditures in 2000 on sour gas activities in the selected four municipalities studied amounted to $720 million: $230 million in RockyView/Foothills, $335 million in Clearwater County, and $155 million in Saddle Hills County. The four municipalities were able to capture about 20 per cent, roughly $150 million, of these expenditures. Local labour accounted for $35 million, with the balance of $115 million spent on local goods and services,[12] landowner payments and municipal taxes. This economic activity supports a total of 930 jobs (direct plus spin-off) and over $50 million in labour income (direct plus spin-off) for some residents in these areas. Table 2 summarizes the estimated economic benefit associated with sour gas activity for each of the municipal areas.

Seismic expenditures ranged from $20 million in Saddle Hills County to $30 million in both RockyView/Foothills and Clearwater County. Seismic expenditures were generally split among labour (35 per cent), materials and services (35 per cent), and fees, primarily for surface access (30 per cent). A typical 2-D seismic program in Alberta is 25 kilometres in length, costs roughly $200 000, and involves 30 people working 108 person-days. Almost all of the labour originated from outside the municipalities, with roughly 10 per cent of the labour being sourced locally. About 55 per cent of the materials and services required were sourced locally. The fees to landowners were assumed to remain in the local economy. Overall, about 40 per cent of seismic

[12] The local goods and services amount is expressed in purchaser's prices.

expenditures were assumed to remain in RockyView/Foothills and Clearwater County and about 32 per cent in Saddle Hills County. Seismic activity attributed to sour gas supported (direct plus spin-off) 51 jobs (FTE) in RockyView/Foothills, 60 jobs (FTE) in Clearwater County, and 15 jobs (FTE) in Saddle Hills County. An estimate of the labour income associated with these jobs is provided in Table 2.

Table 2. Summary of municipal jobs and labour income results (year 2000)

	Seismic		Drilling		Sour gas processing		Total	
	Jobs	W&S $M	Jobs	W&S $M	Jobs	W&S $M	Jobs	W&S $M
Rocky View/Foothills	51	2.0	111	4.5	120	9.1	282	15.6
Clearwater County	60	2.1	218	8.6	275	19.8	553	30.6
Saddle Hills County	15	0.9	38	1.8	43	3.1	96	5.8
Total	126	5.0	367	14.9	438	32.0	931	52.0

[1] # Jobs for seismic and drilling are direct plus spin-off and are expressed as a full-time equivalent (FTE).
[2] W&S $M is wages and salaries expressed in millions of dollars and includes direct plus spin-off labour income and supplementary labour income.
Sources: Alberta Finance and EUB.

Drilling and completion expenditures (including well tie-in costs) attributed to sour gas were estimated at $83 million for RockyView/Foothills, $187 million for Clearwater County, and $86 million in Saddle Hills County. Due to their mobility, drilling contractors tend to be located in the regional centres of the province, such as Calgary, Edmonton, Red Deer, Grande Prairie, and Brooks, and drill crews usually follow the drill rig. Therefore, only a small portion of the labour requirements is sourced within the municipality in which the drilling activity takes place. Overall, it was assumed that 17 per cent of drilling expenditures would be spent locally in RockyView/Foothills and Clearwater County and about 12 per cent of this spending would be captured by labour and businesses located in Saddle Hills County. Drilling activity attributed to sour gas supported (direct plus spin-off) 111 jobs (FTE) in RockyView/Foothills, 218 jobs (FTE), in Clearwater County and 38 jobs (FTE) in Saddle Hills County. An estimate of the labour income is provided in Table 2.

Sour gas processing's annual operating expenditures amounted to an estimated $280 million for the 23 sour gas plants located in the four municipalities. This total was distributed as follows: RockyView/Foothills, $120 million; Clearwater County, $115 million; and Saddle Hills County, $45 million. An estimate of the amount of spending that local labour and businesses were able to capture in each of the municipalities was based on information obtained from the individual plants. In RockyView/Foothills, Clearwater County, and Saddle Hills County the capture rates were estimated at 15 per cent, 30 per cent, and 20 per cent respectively. Sour gas processing activity supported (direct plus spin-off) 120 jobs in RockyView/Foothills, 275 jobs in Clearwater County and 38 jobs in Saddle Hills County. An estimate of the labour income associated with these jobs is provided in Table 2.

In RockyView/Foothills there were roughly 280 jobs supported by sour gas activities, 110 directly and another 170 created through the multiplier or spin-off process. This produces a calculated employment multiplier of 2.5, which means that for every job in the sour gas industry, another 1.5 jobs were supported with their suppliers and in the service industry operating within the two municipalities. Sour gas processing plants accounted for roughly 70 per cent of the job impact, with the remaining 30 per cent roughly split between seismic and drilling activity. The number of plant workers residing within a municipality is a key factor behind the jobs impact. Roughly 30 per cent of the

plant workers resided within Rocky View and Foothills or in the towns and villages located within the municipal boundaries. Due to the closeness to Calgary, the municipalities only captured about 12 per cent of the expenditures by sour gas processing plants on goods and services.

In Clearwater County about 550 jobs were supported by sour gas activities, 210 directly and another 340 created through the multiplier or spin-off process. The employment multiplier was calculated at 2.6, which means that for every job in the sour gas industry, another 1.6 jobs were supported within the municipality. Sour gas processing plants accounted for about 80 per cent of the job impact, with the remaining distributed between seismic at 5 per cent and drilling at 15 per cent. The number of plant workers residing within the municipality was again a key factor behind the jobs impact. However, in Clearwater County, employment associated with suppliers and the service industry was also a significant factor. Roughly 55 per cent of the plant workers resided within the municipality's boundary (which was assumed to include persons residing in Rocky Mountain House, Caroline, and First Nations communities). Because of the urban service base in Clearwater County, local labour and businesses were able to capture about 26 per cent of the expenditures made by sour gas processing plants on goods and services.

In Saddle Hills County there were roughly 100 jobs supported by sour gas activities, 60 directly and another 40 created through the multiplier or spin-off process. The employment multiplier was calculated at 1.7, which means that for every job in the sour gas industry, another 0.7 jobs were supported within the municipality. Sour gas processing plants accounted for about 60 per cent of the job impact, with the remaining 40 per cent split between seismic and drilling. Plant workers residing within the municipality is the key factor behind the jobs impact. Roughly 40 per cent of the plant workers resided in the municipality. The municipality was assumed to capture about one-quarter of the expenditures made by the gas processing plants on goods and services. A discussion of the types of goods and services sourced within each municipal area is provided in the next section.

Lease payments (wells and pipelines) combined with payments by seismic companies to landowners total an estimated $20 million for the four municipalities.

4.1.3 Business Opportunities

Business opportunities were examined in terms of the potential for businesses operating within the municipality to supply goods and services needed as input to the sour gas activities. A breakdown of gross production by industry is one of the IO model outputs. Using this information, it is possible to estimate the increased output associated with each industry sector active in the municipality. The following is a summary of the business opportunities by broad industry category for each of the selected municipalities.[13]

In RockyView/Foothills, sour gas-related expenditures of $230 million generate $16.5 million in increased output at the municipal level. Over 95 per cent of this increased output was accounted for by the following six industry categories:

- Transportation (primarily trucking) $3.4 million
- Wholesale and retail trade $3.0 million
- Professional and technical services $2.8 million
- Construction, repair, and maintenance $2.7 million

[13] The local output numbers are expressed in producer's prices.

- Other business and personal services $1.9 million
- Accommodation and food services $1.9 million

In Clearwater County, sour gas-related expenditures of $335 million generate $32.6 million in increased output within the municipality. Over 95 per cent of this increased output was accounted for by the following six industry categories:

- Construction, repair, and maintenance $8.1 million
- Professional and technical services $7.2 million
- Transportation (primarily trucking) $5.2 million
- Accommodation and food services $4.7 million
- Wholesale and retail trade $4.2 million
- Other business and personal services $2.0 million

In Saddle Hills County, sour gas-related expenditures of $155 million generate $4.4 million in increased output within the municipality. Almost 95 per cent of this increased output was accounted for by the following five industry categories:

- Transportation (primarily trucking) $1.4 million
- Construction, repair, and maintenance $1.4 million
- Professional and technical services $0.6 million
- Other business and personal services $0.4 million
- Wholesale and retail trade $0.3 million

The differences among the municipalities are evident in the output multiplier, which indicates that for every $1.0 million in expenditure by the sour gas industry, output would increase by $70 000 in RockyView/Foothills, $100 000 in Clearwater County, and $30 000 in Saddle Hills County. Given its distance from the large urban centres of Calgary and Edmonton and its service base in Rocky Mountain House, Clearwater is able to realize the largest increase in local output as a result of sour gas activity. While RockyView/Foothills has a significant service base in the towns and villages located within the municipalities, the close proximity to Calgary and Airdrie results in expenditures leaking to businesses in the cities. Because the service base in Saddle Hills County is in the early stages of expanding in response to economic activity associated with the oil and gas industry, Saddle Hills County relies mostly on the service base in Grande Prairie.

4.1.4 Corporate Community Support

It is important to emphasize one aspect of the expenditures made by the sour gas producers: the money spent in the community to support such things as charities, services organizations, schools/education, amateur sports, and recreation. The amount of spending for community support does vary from year to year, but on average local contributions were in the range of $5000 to $15 000 per company, based on information obtained from the plants surveyed in the four municipalities. In addition, many of the companies reported contributions to projects/groups outside the municipality or on regional or province-wide initiatives that are not included in the range cited above. Corporate community support was stressed as an important benefit by both the I-79 Committee and by residents interviewed for the study. The contributions were an important benefit because the money often leveraged other monies and it was spent in areas where it was generally difficult to raise money from other sources. Another important aspect of community support cited was time provided to employees to volunteer in community service organizations and other volunteer activities.

4.2 Municipal Net Financial Benefit

The municipal net benefit calculation focuses on the impact sour gas development has on a municipality's revenues and costs. The net financial benefit is calculated as the difference between municipal revenues from sour gas development and any incremental costs to the municipality caused by the presence of the industry. This section summarizes the findings with respect to the municipal net financial benefit.

4.2.1 Municipal Sour Gas Revenues

The revenue associated with the sour gas industry differed for each municipality, depending on the extent of sour gas facilities within the municipal boundaries. Furthermore, the relevance of sour gas revenues to total municipal revenues varied, depending on the diversity of the assessment base. For example, the tax base in Rocky View and Foothills was dominated by the residential sector, whereas the tax base in Clearwater County and Saddle Hills County was dominated by nonresidential assessment and, in particular, industrial assessment associated with the oil and gas industry.

In Rocky View and Foothills, where a high proportion of municipal revenues were derived from residential assessment, the sour gas industry accounted for around 6 per cent of total revenues. However, in absolute terms, the contribution of the sour gas industry was still significant. The municipalities of Clearwater County and Saddle Hills County had a greater reliance on industrial assessment for tax revenues, and sour gas activity accounted for roughly 23 per cent of total tax revenues. A summary of municipal revenues and the proportion attributable to sour gas are shown in Table 3.

Table 3. Summary of municipal sour gas revenues

	Rocky View	Foothills	Clearwater County	Saddle Hills County
Total municipal revenues	$24 400 000	$16 200 000	$18 200 000	$9 900 000
Sour gas-related revenues	$1 581 000	$960 000	$4 155 000	$2 257 000
Sour gas revenue as % of total	6.4%	5.9%	22.8%	22.8%

Source: EUB.

Certain types of municipal assessment are also subject to provincial education tax. This tax is not collected on machinery and equipment but is collected on residential, nonresidential, and linear assessment. The province calculates the amount that every municipality must contribute towards the public education system. Therefore, the presence in a municipality of sour gas pipelines and sour gas wells, which are assessed as linear property, may reduce the amount of education tax to be collected from other types of property. There may also be an external benefit, since the province pools the education property tax dollars and distributes them to school boards throughout the province on a per-student basis.

Municipalities also receive other revenues, primarily in the form of grant money provided by the provincial government. As natural gas royalties constitute an important part of the Government of Alberta's revenue, the natural gas industry, and in turn the sour gas industry, is an indirect source of revenue for the municipalities. In some instances provincial grants are provided for operating expenditures, but typically grants are in the form of cost-shared infrastructure investments. The provincial government's distribution of grants is not specific to a resource producing area; instead grants are distributed based on the infrastructure needs of all municipalities. However, municipalities experiencing

growth in industrial development are often where additional infrastructure investments are needed.

Table 4 lists the revenue amounts and the percentages for the different types of sour facilities present in each of the municipalities studied. Assessment on sour gas wells generates the largest share of sour gas revenue in each of the municipalities except Clearwater County. Sour gas pipelines and sour gas processing plants also contribute significantly to municipal revenues. In fact, sour gas processing plants represent the largest source of revenues in Clearwater County and the second-largest share of revenues in Rocky View, Foothills, and Saddle Hills County. Pipelines represent the second-largest share of sour gas revenues in Clearwater County. As there is considerable overlap among facility types within each category of assessment (i.e., wells and pipelines within linear assessment and wells and plants within machinery and equipment and buildings and structures), the facility types in many instances share the same tax rate. Therefore, the different levels of revenue attributable to each facility type are primarily due to the different mix of facilities present in each municipality, not to differential treatment among the facility types within the tax structure.

Table 4. Summary of municipal sour gas revenues by facility type

	Rocky View		Foothills		Clearwater County		Saddle Hills County	
	$'000	%	$'000	%	$'000	%	$'000	%
Sour gas wells	614	40	492	52	743	18	1006	45
Processing plants	491	31	258	27	1838	44	580	26
Pipelines	466	29	204	21	1572	38	655	29
Total	1571		954		4153*		2241	

* The total does not include tax revenues derived from assessment on railways, which also have a sour gas component.
Sources: MD of Rocky View, MD of Foothills, Clearwater County, Saddle Hills County, Alberta Municipal Affairs, and EUB.

4.2.2 Municipal Sour Gas Costs

The categories of costs associated with sour gas activity were similar among the municipalities, although differences in the size of the costs were observed. Infrastructure costs and, in particular, expenditures on roads (operating and capital) represented the largest cost incurred by municipalities due to the presence of sour gas development. Other costs included administration activities associated with reviewing emergency response plans (ERPs) and the inspection of sour gas facilities. In addition, expenses were incurred for H_2S safety courses and safety equipment.

Administrative costs depend on the number of staff dedicated to these responsibilities in each municipality. They ranged from about $16 000 in Rocky View to $200 000 in Clearwater County. Road costs (operating and capital) associated with sour gas were higher, ranging from $100 000 in Clearwater County to $600 000 in Saddle Hills County. Operating costs for roads include expenditures for road maintenance, while capital costs include expenditures for road upgrades and new construction. A summary of the costs estimated for each of the municipalities is in Table 5.

Table 5. Summary of municipal sour gas costs

	Rocky View	Foothills	Clearwater County	Saddle Hills County
Total municipal expenditures	$24 800 000	$16 100 000	$17 900 000	$9 200 000
Sour gas-related expenditures				
Operating	$174 000	$366 000	$306 000	$215 000
Capital	$147 000	$73 000	$26 000	$422 000
Total	$321 000	$439 000	$332 000	$637 000
Sour gas exp. as % of total	1.3%	2.7%	1.9%	6.9%

Sources: MD of Rocky View, MD of Foothills, Clearwater County, Saddle Hills County, Alberta Transportation, and EUB.

4.2.3 Net Financial Benefit

The net financial benefit was calculated by subtracting sour gas-related municipal expenditures from sour gas-related revenues. A summary of the calculated net financial benefit is in Table 6.

Table 6. Summary of municipal net financial benefit

	Rocky View	Foothills	Clearwater County	Saddle Hills County
Estimated sour gas revenues	$1 581 000	$960 000	$4 155 000	$2 257 000
Estimated sour gas costs	$321 000	$439 000	$332 000	$637 000
Net financial benefit	$1,260 000	$521 000	$3 824 000	$1 621 000

Source: EUB.

The revenues associated with sour gas development are positively correlated with the size and number of sour gas facilities within the municipality. Clearwater County, for example, is one of the largest sour gas processing regions in the province, with yearly marketable gas deliveries of roughly 13 10^9 m^3. Conversely, Foothills is a relatively small sour gas processing region, with yearly marketable gas deliveries of approximately 1.2 10^9 m^3. The total value of sour gas assessment is the primary determinant of the size of the net financial benefit, notwithstanding that differences in mill rates among the municipalities is also a contributing factor. With the exception of Saddle Hills County, the total value of sour gas assessment matched the ranking of net financial benefit across the four municipalities. The total sour gas assessment in Saddle Hills County was lower than Rocky View but produced a larger net financial benefit due to Saddle Hills County's higher tax rates on nonresidential assessment.

In all cases, there was a positive net financial benefit to the municipality. Costs were higher in areas like Saddle Hills County, where the road infrastructure was expanding to meet the needs of industry. In Rocky View and Clearwater County, the road infrastructure was already well established and the total costs were lower. It would seem from this analysis that road costs related to sour gas tend to level off as the natural gas industry in the municipality becomes more established.

Another way to think about the relative importance of the municipal net financial benefit associated with sour gas is to examine what impact the sour gas industry has on reducing the municipal tax rates. As an illustration, the sour gas assessment for each municipality was removed from the municipality's assessment base to determine the impact on the residential tax rate. The tax rates were recalculated to determine the increase in taxes that would be needed to generate an additional amount of revenue equivalent to the municipal net financial benefit. In other words, without the sour gas industry, both revenues and costs would be lower for each municipality, and the amount of additional revenue that would need to be raised is determined by the extent revenues exceed costs. Tax rates would need to be increased to offset the lost sour gas assessment, but only to the extent

that the "net" revenue shortfall is recovered. To make the calculation, it was assumed that the ratio between residential tax revenues and nonresidential tax revenues would remain the same, i.e., increase proportionally. This simple exercise is only provided for illustrative purposes, it does not adjust for changes to the population base in the absence of the sour gas industry, nor does it incorporate any dynamic impacts that may result in the absence of the sour gas industry; for example, it would not account for increased housing construction in an area where sour gas setbacks are currently restricting residential development.

If sour gas revenues were lost to the municipalities, the residential mill rate would increase for each of the municipalities as follows:[14]

- Rocky View – 12 per cent increase, or $114 on average per household;
- Foothills – 6 per cent increase, or $67 on average per household;
- Clearwater County – 55 per cent increase, or $215 on average per household; and
- Saddle Hills County – 33 per cent increase, or $176 on average per household.

4.3 Impacts of Sour Gas Development on Local Residents

The Committee appreciates that individuals or small communities within a municipality are impacted (positively and negatively) in different ways and to different degrees depending on their circumstances. An individual may be positively impacted (or at least compensated) when a direct benefit is obtained from the presence of the sour gas industry, such as through a job or business opportunity or through payment for use of land. On the other hand, a bad experience with a sour gas operator or simply a lack of confidence in the safety of sour gas operations may cause individuals to feel negatively impacted. To be asked to accept even a small new risk or the need to commit personal time and resources to deal with the sour gas issues causes some to feel that the sour gas industry is an unwanted intrusion into their life. Clearly, individual circumstances and values shape how an individual will weigh the benefits and costs of sour gas development.

The remainder of this section summarizes comments and concerns expressed by a select number of individuals that were interviewed for this study regarding the impact that sour gas development has had on their community. They are categorized as follows:

- **Monetary impacts** – The time spent by individuals in dealing with sour gas issues, property value changes, the impacts of sour gas development on land use, identifiable out-of-pocket costs attributed to sour gas development, and compensation paid by sour gas operators to landowners for access to their land.

- **Safety, environmental, and lifestyle impacts** – The topic of safety includes concerns regarding safety of the sour gas industry in general and the safety practices of sour gas operators in particular. Environmental issues include the effect of sour gas production on air and water quality, noise levels, and wildlife habitat. Lifestyle issues focus on changes to a resident's way of life as a result of sour gas development.

[14] The effect on tax rates is likely understated, given that adjustments should also be made to the population base and in turn the amount of residential assessment to reflect a difference in population if the sour gas industry were not present.

- **Human and animal health impacts** – Concerns with respect to uncertainty around the effects of long-term, low-level sour gas emissions on human and animal health.

- **Resident, regulator, and industry relationships** – The view local residents have about their relationship with the sour gas industry and the EUB.

4.3.1 Monetary Impacts

Time: Many local residents interviewed attached a monetary value to the amount of personal and professional time spent dealing with sour gas development issues for which there is no compensation—time spent becoming educated about the industry, meeting with and negotiating with sour gas operators, preparing for and participating in appropriate dispute resolution (ADR) sessions or EUB hearings, attending synergy group and operator information meetings, and monitoring the activities of operators in their vicinity. For example, the Calgary North H_2S Action Committee (CNH2SAC) detailed the time commitment for association members to prepare for and participate in an EUB hearing regarding an application for a level-4 critical sour gas well: 10 people spent roughly 1720 hours collectively preparing for and participating in the hearing.

Property value changes and land-use impacts: Views on how sour gas development affects property values differed among the municipalities. In Clearwater County, the residents interviewed experienced an increase in property values, which they attribute to increased competition for land. Agriculture, recreation, oil and natural gas, and acreage development all compete for land in this area. Similarly, certain residents of Saddle Hills County generally felt that property values had increased or remained flat once the sour gas industry became part of the community. Various residents of Foothills also saw an increase in property values in their area; however, they believed that this was in spite of the sour gas industry's presence. Landowners in Rocky View that were interviewed generally viewed the existence of sour gas facilities on or adjacent to their land as having a negative impact on property values.

There were also comments on the impact sour gas facilities had on a landowner's ability to optimize use of the land. Again, views differed. A common concern was that agricultural land was being taken out of production. Other concerns expressed included difficulty farming around facilities, lack of weed control, damage to land caused by untrained industry personnel, and sour gas setbacks restricting the potential for land development.

Other out-of-pocket costs: One example mentioned was the professional fees paid to lawyers and consultants during disputes with industry. However, it was acknowledged that in most cases these costs were refunded if related to public hearing participation.

Compensation: Generally, the residents interviewed believe that the compensation paid to landowners in return for access to their land was a benefit associated with sour gas development. However, while some felt they were treated fairly, others believed that the level of compensation did not reflect the value of their land or the value of their time spent dealing with sour gas issues. However, it was generally accepted that those individuals receiving compensation received a monetary benefit.

Many residents, including landowners receiving compensation payments, pointed to the fact that compensation payments were only made to those landowners whose land was

used to accommodate the sour gas infrastructure. Adjacent landowners who may also be affected by the sour gas development did not receive compensation.

4.3.2 Safety, environmental, and lifestyle impacts

Safety: The safe operation of sour gas facilities was a constant focus and concern for residents, as evident from the information provided to the PS&SG Advisory Committee and also from the interviews conducted through the I-79 process. However, the I-79 interview process revealed an observable difference in the degree of alarm over this issue among the different communities examined.

Some residents in Clearwater County and some in Saddle Hills County expressed that while safety was always in the forefront, they became more comfortable with industry practices after dealing with the issue for several years. In those communities, sour gas operators endeavoured to provide residents with a good understanding of their safety practices. At the time of the interviews, there had been no major incidents in Clearwater County, and residents of Saddle Hills County who had experienced incidents were satisfied with the implementation of the ERP in their area.

The sour gas industry has operated facilities in Rocky View and Foothills for many years. In recent years, both of these areas have seen rapid population growth due to their proximity to the city of Calgary. These areas are rapidly changing from rural to residential. At the same time, the sour gas industry has attempted to develop new gas reserves in these municipalities, sometimes in areas where there have been no sour gas operations previously. In both municipalities, some residents have experienced sour gas pipeline leaks and are increasingly concerned about both the safety level afforded by the industry in general and the operating and safety procedures of companies operating in their areas in particular.

Various residents in Rocky View and Foothills and from the Stoney First Nation Oil and Gas Committee said lack of effective communication was a major safety concern. During a pipeline leak in Rocky View, some residents were not able to contact processing plant personnel. This was remedied with the plant providing the residents in the community with 24-hour access to plant personnel. Many Foothills residents interviewed found the response to a pipeline break in their area to be ineffective and said they had lost trust in the ability of the industry to operate safely or respond to an emergency situation in a way that guaranteed the safety of those living near sour gas facilities. Within the Stoney First Nation, a large percentage of the population uses their native language at home. Therefore, it was difficult for them to understand and react to ERPs for their area.

Environment: Air, water, and noise pollution were identified as the three main areas of concern by many of the residents interviewed.

Air pollution is most noticeable in the form of odours from sour gas operations. Some residents in Saddle Hills County reported they had lived with an intense and constant odour for years before it was remedied. While odours are the most noticeable form of air pollution, a number of residents were also concerned about the degradation of air quality due to emissions from sour gas facilities.

Water quality is becoming an increasingly urgent issue for many individuals. Examples of contaminated water attributed to the sour gas industry were provided in Rocky View

and Foothills, as well as examples of where the water source had disappeared. Members of the Stoney First Nation were also concerned about the water quality on their lands.

Other environmental concerns were visual obstruction, light pollution, loss of wildlife habitat, and noise from compressors, gas processing plants, and increased traffic.

Lifestyle: Lifestyle changes of concern included loss of rural solitude, stress and fear associated with the unknown, increased traffic, and concerns about community and private security. One resident, who had experienced two pipeline leaks on her property, spoke of being concerned every day about her children's safety and about carrying out daily activities on the farm. Generally, individuals who have chosen a rural lifestyle lose the peacefulness and solitude they specifically sought, acquired, and valued when encroached upon by sour gas development.

The impact of sour gas development on the social fabric of a community seems to depend on the length of time the industry has been in the community and the existence of other industry in the community.

In the municipalities of Rocky View and Foothills, which surround the City of Calgary, sour gas development has not had a significant impact on the community in terms of employment growth or new business opportunities relative to the overall growth of these municipalities.

Clearwater County has experienced a noticeable change in the make-up of the community. The once strictly agricultural community is now home to many residents who work in urban centres or in other nonfarming industries in the area, such as the energy industry. The existence of the sour gas industry in this area has contributed to the changing social dynamic by providing full-time employment for both long-time and new residents to Clearwater County. The sour gas industry also provides part-time employment opportunities to farmers and their families to work off of the farm, which helps support their farming way of life.

Some residents in Saddle Hills County credit the sour gas industry for increased employment opportunities. In their view, many individuals who would be forced to move away from the area to find work in larger centres are now able to stay in the community and work for companies involved in the sour gas industry.

4.3.3 Human and Animal Health Impacts

A key concern common to residents interviewed was uncertainty about the effects of sour gas emissions on human and animal health. The effect of acute exposure to toxic concentrations is well understood, but the residents interviewed are looking for answers about the effects of prolonged low-level exposure on the health of their family and livestock. There have been a number of studies that have examined the effects of air emissions from sour gas facilities on animal health (a list of studies is provided in Appendix 5). One example, the SPOG Livestock Study collected data from the fall of 1991 through calving of 2002. Cow production records were examined from seven area cow-calf herds regarding the health and productivity of the herds. Residents interviewed in these communities believed that the study was helpful in understanding the impact of sour gas emission exposure on livestock and contributed to a greater level of comfort among residents. Another example is the Western Canada Study on Animal and Human Health Effects Associated with Exposure to Emissions from Oil and Natural Gas Field

Facilities. This study is being undertaken by the Western Interprovincial Scientific Studies Association, a not-for-profit company that is managed by a Board of Directors composed of officials from the governments of Alberta, British Columbia, Manitoba and Saskatchewan. A herd health study is currently underway but the human health study, which was to run in parallel to the animal health study, is currently on hold and is not expected to proceed until the results from the animal health study are available.

Many of the residents interviewed were looking for more long-term, rigorous scientific research to be undertaken. In their view, this would help people distinguish fact from opinion regarding human and animal health. A commonly held view is that lack of information with respect to emissions and their effects on human health creates anxiety among community members. Current health concerns among some residents included the potential to cause breathing difficulties, including concerns about an increase in child asthma. Additionally, some residents in Rocky View and Foothills felt they were under increasing stress as a result of incremental sour gas development in their area. One resident stated that the advent of sour gas in their community has "changed their life."

4.3.4 Relationship with Industry and the Regulator

Some residents interviewed in the municipalities studied were looking for improved relations with industry participants and in some cases with the EUB.

Consultation: A critical determinant in the degree of satisfaction that residents had with the sour gas industry was the extent and effectiveness of the consultation that took place between residents and sour gas operators. Consultation is important both in the predevelopment phase as well as throughout the life of the facility. A number of residents stated they wanted to know and understand what was being proposed and what was happening in their community. The interviewees were clear that they must believe they are being treated fairly; only then will a sense of trust develop among the community and industry participants. Furthermore, industry's accountability for their operations and the actions of their employees and subcontractors was vital in maintaining the trust between the operator and residents. In situations where a company has failed to be accountable for its own operations, some residents have lost trust, not just in that particular operator, but also in the industry in general.

Synergy Groups: In some instances, representatives from industry and the community have come together to form synergy groups in order to create a better understanding of industry and community issues, educate residents about the energy industry, educate industry about the community, and help resolve issues that arise from industry and public interaction. An example of a successful synergy group is the SPOG, which has been in operation since 1992 and has played a significant role in improving relations between the community and industry in their area.

EUB: Some residents expressed views on how the EUB was carrying out its responsibilities as the regulator of the sour gas industry. Many felt that the staff and Board members of the EUB provide a very useful service and were pleased with their interaction with the regulator. However, concerns were expressed in two areas. First, some expressed frustration with the hearing process, regarding the hearings as too formal and not supportive of public participation. In particular, the large amount of technical information that companies present and interveners must undertake to understand and respond to makes it difficult for local residents to participate effectively in the process. Second, some residents reported disappointment with the EUB's enforcement response to

incidents that have the potential to impact public safety. Some who had experienced operational problems (such as pipeline breaks) in their area believed that the companies responsible should be penalized by the EUB.

5 Summary of Findings

The I-79 Committee draws the following conclusions from its study.

Economic Benefit

- The sour gas industry contributes significantly to the Alberta provincial economy. Throughout the province, the sour gas industry supported over 37 000 jobs (direct plus spin-off) and generated approximately $1.3 billion in wages and salaries. The sour gas industry also has a fiscal impact on the province through natural gas royalties, income taxes, and indirect taxes. The royalty collected on natural gas, natural gas liquids and sulphur from sour gas production in the year 2000 was $1.52 billion, the freehold mineral tax collected from sour gas production was $41 million, and sour gas activities (direct plus spin-off) generated $225 million in provincial taxes.

- In the four municipalities studied, activities associated with seismic, drilling, production, and processing of sour gas accounted for 930 jobs (direct plus spin-off) and generated approximately $50 million in wages and salaries. The employment impact in each municipality was estimated at 280 jobs in Rocky View and Foothills, 550 jobs in Clearwater County, and 100 jobs in Saddle Hills County. Labour income associated with this employment was estimated to be $15 million in Rocky View and Foothills, $30 million in Clearwater County, and $6 million in Saddle Hills County.

- The number of business opportunities created from sour gas development in a municipality depends on the ability of the local economy to provide services and materials required by the sour gas industry. The extent to which local labour and businesses were able to capture these expenditures varied among the municipalities; however, on average, about 20 per cent of the expenditures remained in the local economy. In terms of increased output, local businesses providing goods and services in construction and maintenance, professional and technical services, transportation, wholesale and retail trade, and business/personal services were best able to capture the spending associated with sour gas activities.

- The Committee did not have quantitative information to analyze the impact of sour gas development on the local economies of First Nations communities. However, through the interview process, the Committee was made aware that there is an expectation by First Nations that sour gas development near their communities should create more employment opportunities for their people than they currently experience.

- Lease payments (wells and pipelines) combined with payments by seismic companies to landowners total an estimated $20 million for the four municipalities.

- Some producers active in the sour gas industry within the municipalities provide direct corporate support to charitable organizations, community projects through financial contributions and employees active in volunteer roles. This support is appreciated within the community and is acknowledged as an important local benefit.

Municipal Net Financial Benefit

- Sour gas activities and the spin-off economic activity that is created generate roughly $60 million in gross revenues for the over 50 municipalities in which the sour gas industry operates. In each of the four municipalities studied, the revenues generated through taxation of the sour gas industry exceeded the incremental costs born by the municipality to support the presence of the industry. The financial net benefit for the year 2000 was calculated to be $1.3 million for Rocky View, $0.5 million for Foothills, $3.8 million for Clearwater County, and $1.6 million for Saddle Hills County.

- The revenues received by a municipality from the sour gas industry have an effect on the residential mill rate in each municipality. It was estimated that without the financial contributions of the sour gas industry, the mill rate in each of the four municipalities would rise by the following amounts: Rocky View, 12 per cent, Foothills, 6 per cent, Clearwater, 55 per cent, and Saddle Hills, 33 per cent.

- Generally, the committee observed that the smaller the existing tax base of a municipality (i.e., lack of industrial activity and more sparsely distributed population), the more significant the financial impact associated with the sour gas industry. The importance of the net financial benefit is less in areas with a large residential tax base or in municipalities that have a large commercial and industrial tax base other than the sour gas industry.

Impacts of Sour Gas Development on Local Residents

- The sour gas industry generates economic benefits for the province and for municipalities, which are shared among residents. However, as the sour gas industry grows and as population centres expand, an increasing number of people are now faced with sour gas development in their communities. Some residents who live near sour gas facilities have concerns about the industry with respect to safety, health, the environment, lifestyle, and the time commitment required to deal with sour gas issues. In their view, these concerns must be balanced against the economic benefit that sour gas development generates.

- Increased certainty about the impacts of sour gas development would allow residents to better evaluate the effects of sour gas development. There have been a number of research studies conducted in Alberta that have examined such topics as acid deposition and livestock health; nonetheless, some residents interviewed within the four municipalities requested that further scientific work be conducted into the long-term impacts of sour gas operations on water, air, and soil quality. Additionally, a number of residents requested that more studies be conducted into the human and animal health effects of prolonged exposure to low levels of sour gas emissions.

- When meaningful consultation occurs between sour gas operators and local residents in the predevelopment stage of a project, an effective working relationship is usually developed. Residents interviewed in the four municipalities want to be informed regarding operations in their area and expect sour gas operators to conduct their operations in a manner that protects the residents' safety.

- The residents interviewed also indicated they expect the sour gas industry to be accountable for their operations and the actions of their employees and contractors.

Failure on industry's part to communicate with residents or to take responsibility for operating problems destroys trust between industry and residents and leads to conflict. In some instances industry and the community have come together to form a synergy group in order to create a better understanding of industry and community issues and to help resolve conflicts that may arise from industry and public interaction. A successful synergy group can play a significant role in reducing tension between community and industry.

5.1 Concluding Remarks

This study has shown that sour gas activities generate benefits for the province and also for the municipalities where they operate. Regardless of where one lives in the province, all Albertans enjoy some share of the provincial benefit. Albertans living in an area where the sour gas industry operates may also receive a share of the local benefits generated, perhaps directly through employment or business income or indirectly through the net financial benefit accruing to the municipal government. Nevertheless, some people argue that those who live near sour gas operations experience costs and are negatively impacted in ways others are not, and suggest that these impacts are not adequately offset by the their share of the benefit.

The I-79 Committee's study provides a detailed quantification of local benefits at the municipal level for individuals to consider within the context of their own circumstances. It does not provide a full accounting of costs or negative impacts that may be experienced by some individuals and therefore does not attempt to balance benefits and costs on behalf of all affected by sour gas development. Nevertheless, the I-79 Committee notes that many of the recommendations made to the EUB by the Advisory Committee are directed at the same key areas of concern raised during this study. It is anticipated other recommendations may increase the level of understanding and certainty about health and safety issues, will explore equitable solutions to impacts such as sour gas setbacks, and will increase the level of confidence that people have in the sour gas industry and its regulation.

Appendix 1 Recommendation 79 Stakeholder Steering Committee

Committee Members

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Appendix 2 Costs and Benefits of Sour Gas Development Identified by the I-79 Committee

COSTS

Tangible Costs

Individual and Community

- Onus on local residents to hire appropriate help and fund interventions up front
- Land value
- Land-use impacts:
  - decreased productivity (soil disturbance)
  - increased weed control costs
  - development restrictions
  - land out of production
  - inconvenience for farming operations
- Contaminated site costs:
  - affects access to capital
  - decreases value at time of sale
- Community Infrastructure costs:
  - wear and tear on existing infrastructure
  - new infrastructure required to support increased, transient population (police, ambulance)
- Emergency preparedness
- Increased costs to maintain roads

Intangible Costs

Individual and Community

- Quality-of-life issues
  - Noise
  - Nuisance
  - Privacy
  - Health
  - Inconvenience
- Air and water quality
- Lost opportunity value of land
- Time and energy to acquire knowledge to be on the same playing field as oil companies to make knowledgeable decisions and presentations

Provincial

- Water use/water quality

BENEFITS

Direct Benefits

Individual and Community

- Job opportunities:
  - increase in total jobs
  - creation of local economy vs. commuter economy
- Property tax revenue
- Increased wages
- Landowner compensation
- Community support and involvement
- Property values
- Increased community population
- Decreased education costs

Provincial

- Royalties and taxes
- Employment
- Standard of living

Indirect Benefits

Individual and Community

- Business opportunities (restaurants, hotels)
- Spin-off employment as a result of business opportunities

Provincial

- Supplies societal needs

Appendix 3 Economic Benefit Calculation—Methodology, Analysis, and Assumptions

This appendix examines the methodology, analysis, and assumptions used to assess the economic benefits to communities impacted by sour gas development.

1 Methodology

Benefits may be defined in terms of economic impacts or more broadly in terms of social benefits. Economic impacts are the impacts on the level of economic activity in a given area. They are not social benefits except insofar as a social benefit may also affect an area's level of economic activity. The broader definition of social benefit, which typically involves conducting an economic benefit-cost (B/C) analysis, includes identifying all the benefits and costs, including valuation of changes in amenity or quality-of-life factors, such as health, safety, air quality, and noise. However, quantifying benefits and costs that do not have easily identifiable market prices requires assigning a market value or, in economic terms, specifying a "shadow price." Specifying shadow prices requires studies to determine what individuals are willing to pay for the various impacts (e.g., for clean air). Economic B/C analysis is a rigorous, data-intensive procedure that is beyond the intent of Recommendation 79. However, it is recognized that without this cost information, the study will not provide all of the information needed to make a full net benefit calculation. Then, again, there is considerable scientific work being undertaken by other PS&SG initiatives related to recommendations dealing with safety and health. It is important that this work be completed first, as a B/C analysis is most useful when impacts can be translated into benefits and costs with reasonable certainty.

An alternative to adopting the broad social benefit definition is to measure economic benefit in terms of economic impact, including

- industry output (sales volume),
- value added (gross domestic product),
- personal income, and
- jobs.

Using this definition, economic benefit is associated with the impacts of changed employment opportunities, wages, and other income determinants. Job creation is the most widely understood and appreciated definition of economic benefit. Other measures of economic benefit, such as industry output or gross domestic product (GDP), are also legitimate indicators of economic activity but may be less understood by the public.

To measure economic benefit in these terms, the input-output (IO) impact analysis technique is used. IO analysis relies on a complex input-output model that reflects the linkages between sectors of the economy and how they interact with one another in the production and consumption of goods and services. With IO analysis, it is possible to trace the impacts of expenditures in one industry as this spending works its way through other industry sectors operating in the economy. In other words, an IO model will measure the impact of industrial activity and the corresponding rounds of industry output in other sectors (multiplier or spin-off impacts) that combine to expand the local economy.

Economic impacts also lead to fiscal impacts, or changes in government revenues, which can be measured with a tax model that provides an estimate of taxes generated at the various levels of government. The level of taxes is dependent on the industrial output and income measured by the IO model.

Changes in economic activity can also cause hardship to people's lives. For example, economic growth can bring increased pollution or increased traffic congestion, or it can reduce land-use options. IO analysis does not capture these dynamic economic impacts. To ensure that these impacts are not ignored, they are acknowledged and dealt with in a qualitative manner within the study.

The remainder of this appendix outlines the strengths and weaknesses of the IO analysis methodology and its applicability to the study.

2 Input-Output Impact Analysis

IO analysis is an appropriate methodology to use in estimating the economic benefit associated with sour gas activities because the technique is well developed and widely accepted and it provides a detailed view of the benefit or the "economic worth" of an industry to a local economy. IO models allow the analyst to examine the economic impact beyond the direct expenditure impacts of an industry's activity to estimate the multiplier, or spin-off, impacts. As a result, IO analysis is typically used to address the following types of questions:

- What are the gross economic impacts in terms of output and income that would result from expenditures in a particular industry sector?
- How will employment levels be affected?
- What is the impact on output, income, and employment in other sectors of the economy?

2.1 Input-Output Model

The economic impacts were measured using the 1998 Input-Output Impact Model maintained by the Statistics Branch of Alberta Finance. This 1998 model is the latest available and has the release date of November 2002.

The 1998 IO Model was constructed using 168 industry, 476 commodity, and 180 final demand categories. The inter-industry interactions are recorded at this level of detail in the input-output tables. These interactions identify in detail who produces what (the industry origins of a particular commodity) and who buys what (the distribution of commodities among purchasing industries and final demand). The IO tables provide a statistical representation of how an economy's industries interact with one another at a specific point in time.

The most commonly known output of the IO model is the economic multiplier. The multiplier concept is simply the mathematical ratio of the total impacts, including the direct plus spin-off, to the direct impacts of a given activity. The direct impacts arise from expenditures made by the industry sector being studied. The spin-off impacts are defined in economic terms as the indirect impacts plus the induced impacts. Indirect impacts are the changes to production, employment, and incomes in the industry sectors that supply goods and services in response to the direct expenditures and in turn the

industry sectors that supply goods and services to the suppliers as they increase their output. For example, if steel were purchased, then steel mills would have to increase their output to meet demand. An increase in the output of steel would require increased output in the mining sector to provide iron ore. An increase in each of these two sectors would require an increase in the output of the transportation sector to transport the iron and steel, and so on. Induced impacts result from the (re)spending of the labour income paid by each sector that expands to supply inputs to other sectors. These expenditures help to support retail businesses that in turn pay wages, which are (re)spent, and so on.

There are two main types of multipliers: Type I is "open" where multipliers reflect only the direct and indirect impacts, specifically excluding the household sector or the (re)spending of labour income. Type II is "closed" where multipliers include induced impacts as well as direct and indirect impacts. These multipliers are derived from the closed model, i.e., closed to households. With the closed version of the IO model, the household sector is treated as a production sector. It is assumed that households, after withdrawing a portion of their income for savings and taxes, spend the rest of their income on consumer goods and services. Closing an IO model to households increases the interdependence of the system and results in a higher impact, leading to larger multipliers, than those based on the open model. The closed model was used for this study.

A consequence of using an IO model is that the analysis is limited in terms of how small a community can be defined. The community definition has to be large enough so that expenditure and financial data are readily available for the defined community. For this reason, the analysis was conducted at the municipal and provincial levels.

The Alberta IO model measures economic impacts at the provincial level. To estimate the impact at a municipal level, data on the direct municipal impact were collected from industry and an estimate of the spin-off, or multiplier, impact was made by weighting the indirect and induced impacts based on the industrial/service capacity of the economy in each municipality.

The IO model will not measure intermunicipal impacts; for example, there may be some residents in the municipalities studied who are employed in the sour gas industry but working outside the municipality. In this case, the municipality is benefiting in terms of employment in the sour gas industry but this is not counted because the residents work outside the municipality. Hence, the municipal impacts will be somewhat understated.

2.2 Data Requirements

One reason for selecting IO analysis to measure economic benefit is that expenditure-based data are often the most readily available. Information can be collected from companies operating in the industry and from aggregate data collected by government agencies and industry associations.

Economic impacts are sensitive to the size and type of expenditures and to the structure of the economy. The amount of the expenditures is important because the magnitude of the economic impacts is positively related to the size of the expenditures. The type of expenditures is important because to the extent that an industry activity needs goods and services that can be sourced locally, the local impacts would be greater. The structure of the economy is important because if most of the materials and services were produced

locally, the economic impact would be greater than if most of the goods and services needed to be imported.

To conduct the IO analysis, information is needed that describes these three factors: the size or amount of spending on labour, goods, and services; the type of goods and services purchased as inputs to the economic activity; and an indication of where the labour, goods, and services are sourced, whether from within the defined economy or from outside the defined economy.

The expenditure data collected must be expressed in producers' prices, defined as the price received directly by the producer of the commodity. Often, expenditures are expressed in a purchasers' price, which includes the producer's price plus the service margins paid to transport the commodity and the wholesale and retail margins/mark-ups and indirect taxes. These margins and indirect taxes must be stripped from the purchasers' price and allocated to the sector that provides the service, e.g., trucking, retail and wholesale. It is often the case that goods are produced elsewhere but are sold locally through a distributor. In this case, the wholesale or retail margin would be sourced locally, whereas the producer's price for the commodity would be allocated outside the defined economy. This calculation is performed automatically within the Alberta IO model when purchasers' prices are specified.

2.3 IO Model Limitations

IO analysis is a useful tool but, like all economic models, it has its limitations:

- The IO model does not account for supply shortages and assumes production increases can be met without a change in capacity – whatever is demanded as a result of increased industry output is assumed will be produced by the economy. Alberta industries are assumed to maintain a fixed share of the market with the remainder imported from outside the province.

- The structure of the economy, the production technology (inputs) and relative process are fixed. One consequence of selecting the IO analysis is that the technique models a specific point in time, whereas, in reality, technological innovations and price adjustments occur regularly.

- IO models reflect industry averages for technology use and average input costs. Therefore, an IO model will not provide a complete or absolute measure of the economic impact.

- IO models tend to overestimate the multiplier effects. For example, if an activity requires a supplying industry to increase its output, the model would show an increase in jobs; however, it is possible that the supplying industry would increase its shipments by increasing productivity and not by hiring extra labour.

- IO models have no time dimension. They assume that the total impact of an industry's activity is experienced instantaneously, when in fact most multiplier effects tend to spread through the economy over time. Furthermore, IO models do not consider the broader economic shifts over time, whether it is changes in population, business location patterns, or land-use patterns.

- IO does not provide a means for directly assessing social or environmental impacts or locational competitiveness.

Because of the limitations associated with IO analysis, the results should be treated as general estimates indicating trends and order of magnitude, rather than as absolute values.

3 Analysis and Assumptions

The remainder of this appendix outlines the steps taken and the assumptions made to calculate the economic benefit associated with sour gas activities at the provincial and municipal level. The appendix is split into six sections: Community Impact – A Case Study Approach; Municipal Impact; Seismic Activity; Drilling Activity; Sour Gas Processing; and Provincial Royalties from Sour Gas Production.

3.1 Community Impact – A Case Study Approach

There were about 50 municipalities in Alberta with sour gas production in 2000. The number of sour gas plants in a municipality ranged from one to as many as 16. The average for all municipalities with sour gas production was 6 plants. There were approximately 200 sour gas plants operating throughout the province that had marketable natural gas production in 2000.

To study each of the 50 municipalities and to collect information on more than 200 sour gas plants was not possible. Instead, the Committee chose a case study approach; a few municipalities with different characteristics were selected from the sour gas producing regions of the province.

The Committee determined that the following criteria should be used to select the municipalities:

- To the extent possible, the selected municipalities should represent other sour gas municipalities in the province.
- The municipalities should be in areas with high H_2S concentrations and a high level of sour gas activity (wells and plants).
- There should be a contrast among the municipalities selected, including population densities, proximity to rural/urban centres, and differing economic base profiles.
- Temporal factors, such as the maturity of the sour gas industry in a community and the likelihood that the sour gas industry will continue to exist and grow in an area, should be considered.
- Areas where sour gas development will likely take place in the future should be considered.

The Committee selected four municipalities to be studied: The Municipal District (MD) of Rocky View, MD of Foothills, Clearwater County, and Saddle Hills County. Table 1 provides background on the municipalities selected and on the average for all municipalities with sour gas processing activity in the province.

Table 1. Case study communities and the average of all sour gas municipalities

	Rocky View	Foothills	Clearwater	Saddle Hills	Average
Population[1]	30 688	16 764	11 505	2 566	6 956
Population density[2]	7.58	4.57	0.62	0.44	1.80
% nonresidential assessment[3]	24%	25%	83%	88%	66%
Sour gas production (10^6 m^3)[4]	4 828	1 259	13 148	3 122	1 568
Number of sour plants	4	3	7	9	6

[1] Statistics Canada, 2001 Census.
[2] Population per square kilometre.
[3] Percentage of municipal revenues from nonresidential assessment.
[4] Raw sour gas receipts, million cubic metres, 2001.
Source: EUB.

The four municipalities selected meet the criteria set out by the Committee by providing a cross-section of municipalities with sour gas production in the province. Specifically:

- The communities range in population size, from over seven persons per square kilometre in Rocky View to less than one person per square kilometre in Saddle Hills County and Clearwater County.

- Clearwater County is one of the largest sour gas producing regions in the province, with yearly marketable gas production of over 13 10^9 m^3. The MD of Foothills is a relatively small sour gas producing area, with yearly marketable gas production of approximately 1.2 10^9 m^3.

- Rocky View and Foothills are adjacent to the urban service base in Calgary. Clearwater County has some services within its boundaries, and Saddle Hills County, a mostly rural municipality, relies for the most part on Grande Prairie as its closest service base.

- Another important consideration is the extent to which a municipality relies on nonresidential assessment to meet its local revenue requirements. A municipality with a high reliance on nonresidential assessment for its tax base may be more receptive to the economic benefit that sour gas development can bring. The municipalities selected range from 88 per cent of revenues from nonresidential assessment in Saddle Hills County to a low of 25 per cent in Rocky View and Foothills. The overall average for sour gas producing regions is 66 per cent.

The economic worth of the sour gas industry in a municipality ultimately depends on the extent to which the sour gas industry is able to purchase goods, services, and labour from within the local economy. The information in Table 2 provides a breakdown of the labour force by industry for each of the selected municipalities. Again, the difference between the municipalities is evident in that Saddle Hills County and Clearwater County (to a lesser extent) have a strong reliance on resource-based industrial activity, while Rocky View and Foothills have a much smaller reliance on resource-based activity. The provincial average is provided for comparison.

Table 2. Labour force by industry (%)

	Rocky View	Foothills	Clearwater	Saddle Hills	Alberta
Agriculture and other resource-based industries	15	13	27	57	9
Manufacturing and construction	17	19	16	10	18
Wholesale and retail trade	14	14	12	4	15
Finance and real estate	5	5	3	2	11
Health and education	13	13	13	11	16
Business services	23	20	10	8	11
Other services	15	17	19	8	20

[1] The labour force by industry percentages includes the labour force located in the towns, villages, and First Nations (cities excluded) within the boundaries of the municipal district or county.
Source: Statistics Canada, 2001 Census.

3.2 Municipal Impact

The labour force data by industry were used to calculate the economic multipliers at the municipal level. To calculate the municipal economic impacts, only the direct spending that remained in the municipal economy (i.e., sourced locally) was entered into the IO model, representing the direct municipal impact. Since the model calculates the indirect and induced impacts on a provincial basis, these multiplier effects had to be reduced to better reflect leakages at the municipal level. To adjust the indirect and induced effects, the impacts by industry detailed in the IO model output were reduced either by the ratio of "municipal labour force by industry" divided by "provincial labour force by industry" or were reduced based on the information provided with respect to the local supply capabilities provided by industry.

Table 3 compares the multipliers produced by the model and the adjusted multipliers, which better reflect the increased leakage at the local level.

Table 3. Adjusted municipal multiplier compared to multiplier calculated by the IO model[1]

	Adjusted multiplier	IO model multiplier
RockyView/Foothills		
Employment	2.6	4.7
Labour income	1.6	2.7
Clearwater County		
Employment	2.6	4.9
Labour income	1.7	2.8
Saddle Hills County		
Employment	1.6	5.5
Labour income	1.4	3.6

[1] A multiplier is simply the mathematical ratio of the total impacts, including the direct plus spin-off, to the direct impacts of a given activity. The direct impacts arise from expenditures made by the industry sector being studied. The spin-off impacts are defined in economic terms as the indirect impacts plus the induced impacts. The IO model multiplier was calculated using the direct expenditures captured by the municipality to estimate the economic impacts using the 1998 Input-Output Impact Model maintained by the Statistics Branch of Alberta Finance.
Sources: Alberta Finance, EUB.

The adjustments made to the multipliers reduced the employment multiplier by as much as 70 per cent in the case of Saddle Hills County and around 45 per cent for RockyView/Foothills and Clearwater County. The labour income multiplier was reduced

by about 60 per cent in Saddle Hills County and by about 40 per cent in the other two municipal areas.

3.3 Seismic Activity

An estimate of seismic expenditures was obtained from the Canadian Association of Petroleum Producers (CAPP) *Statistical Handbook*, Section 4, Table 4.1a, 2001. The net cash expenditures in Alberta for geological and geophysical (seismic) activities were $824.1 million in 2000. The allocation of seismic expenditure by municipality was based on a municipality's share of total drilling activity (available from EUB records). Specifically, the number of wells spudded in 2001 was correlated with the sour gas municipalities of the province to obtain an estimate for seismic activity by municipality. Drilling data for 2001 were used to estimate seismic activity in 2000 because seismic activity precedes drilling activity. It is recognized that seismic activity is not always undertaken in advance of drilling; however, this approach makes the implicit assumption that "speculative" seismic activity follows the same distribution as seismic activity undertaken in advance of drilling.

Information describing the inputs (goods, services, and labour) and expenditure patterns of seismic companies was obtained through discussion with the Canadian Association of Geophysical Contractors (CAGC). For instance, a typical 2-D seismic program in Alberta is 25 kilometres (km) in length and costs roughly $200 000. Seismic activity occurs throughout the province; however, in 2000 the main seismic activity areas were concentrated in the foothills (west) and in the northern areas of the province. Expenditures for seismic surveys are generally split among labour (35 per cent), materials and services (35 per cent), and fees (30 per cent), mostly surface access, and in some cases municipal and provincial fees.

A 25 km 2-D seismic program involves 30 people working 108 person-days to complete the work. Almost all of the labour originates from outside the municipality, with roughly 10 per cent of the labour sourced locally. About 55 per cent of the material and services required are sourced locally, primarily accommodation and meals, fuel, transportation, and a variety of locally supplied personal and business services. The fees to landowners and to the municipality were also assumed to remain in the municipality.

The economic impacts associated with sour gas seismic activities were estimated using custom runs of the 1998 Input-Output Impact Model for each of the municipal areas. To estimate the provincial impact, the total provincial expenditure for seismic activities was input into the model using the industry category Support Activities for Mining and Oil and Gas Extraction.

3.4 Drilling Activity

An estimate of drilling expenditures was obtained from drilling cost data available in the Well-Cost Study reports published by the Petroleum Services Association of Canada (PSAC). Specifically, the cost of a well was determined by taking into account the total depth of the sour gas well and whether the well was completed, abandoned, or drilled and cased. The correlation between the total cost of a well and total well depth was estimated by looking at past well-cost studies (1997-2003) for PSAC Area 2. For completed wells, the completion costs and the costs to tie in the well were included. The typical completion costs were estimated based on cost information obtained from the well cost

studied and the well tie-in costs were estimated based on an average cost for the pipe and for metering. The tie-in cost was assumed at $200 000 per completed well.

There were roughly 10 000 natural gas wells drilled in 2000, split between exploration wells (36 per cent) and development wells (64 per cent). About 1500, or 15 per cent, were sour gas wells. Information on their distribution by municipality was obtained from EUB records. The calculated average drilling cost (excluding tie-in costs) per sour gas well (including completed, abandoned and drilled and cased wells) of $1.4 million in Rocky View, $1.5 million in Foothills, $1.9 million in Clearwater County, and $900 000 in Saddle Hills County. To refine the expenditure estimate for each municipality, the well cost estimates were adjusted to only reflect drilling activity that took place in the calendar year 2000. In other words, if drilling preceded or extended past the year 2000, the drilling days in 1999 and 2001 were excluded from the estimate of drilling expenditures. Well spud dates and drill rig release dates were obtained from EUB records. The well count and total drilling cost estimates for drilling days in 2000 only for the four municipalities examined were as follows:

	No sour wells	Drilling cost ($ million)
Rocky View	34	$44.6
Foothills	24	$33.6
Clearwater County	105	$180.7
Saddle Hills County	88	$78.8

Data describing the inputs (goods, services, and labour) and expenditure patterns of drilling contractors were obtained through discussions with the Canadian Association of Oilwell Drilling Contractors (CAODC) and from drilling cost information contained in the well-cost studies. For instance, a drill crew usually follows the drill rig, and therefore only a small portion of the labour requirements is sourced within the municipality in which the drilling activity takes place. However, service rig operators typically source up to 50 per cent of their labour requirements from the local community. The information gathered indicated that 15 to 20 per cent of the goods and services needed for drilling operations, including construction services, food and accommodation, fuel, trucking, and a variety of personal and business services, were sourced locally.

The economic impacts associated with sour gas drilling activity were estimated using custom runs of the 1998 Input-Output Impact Model for each of the municipal areas. To estimate the provincial impact, the total provincial expenditure for drilling activity was input into the model using the industry category Support Activities for Mining and Oil and Gas Extraction.

3.5 Sour Gas Processing

An estimate of sour gas processing expenditures was obtained by surveying each of the natural gas producers operating sour gas plants in the four municipalities. In total, there were 23 sour gas plants that had marketable natural gas production in 2000. Of these, 17, or 74 per cent, of the plants provided confidential information on the operating costs associated with wells, gathering pipelines, field facilities, and processing plants. Payments for third-party gas processing were included in the plant total, whereas payments made by the plant operator to another operator for processing its gas were allocated to the plant that processed the gas. In a couple of instances where plants only provided processing service (midstream plants), the operating costs associated with wells and gathering pipelines were not fully captured. In addition, capital expenditures for new plants and expansions were not included, as they do not form part of the annual operating

expenditures. Capital spending for drilling new wells and for seismic work was captured separately (as described above) and is not included in a plant's annual expenses.

To protect the confidentiality of the data, plant-specific information was averaged over a minimum of five plants (no single plant information is reported in this study). To achieve the minimum five-plant average for a municipality, it was necessary to combine data collected for plants in Rocky View and Foothills and to report the two municipalities as one region.

An average operating cost per unit of marketable gas production was obtained from the plants responding to the survey in each municipality. The averages were then used to estimate the operating costs for plants that did not provide information. As the focus of the study is on sour gas, if a sour gas plant is processing sweet gas that could otherwise be economically processed at an alternate sweet plant there would be no incremental benefit, as the gas would be processed in either case.[15] In the municipalities' studied, it would be hard to argue that sweet gas production would not get picked up by existing or new sweet gas plants in the area. A sour gas plant receives revenues and incurs an operating cost for processing sweet gas and in order to isolate sweet from sour, it was necessary to subtract those operating costs associated with sweet gas. The easiest way to do this was to reduce operating costs by the percentage of sweet gas to total volumes processed at each sour gas plant. It could be argued that a plant's operating costs for sweet versus sour are not well represented by the proportion of sweet and sour volumes processed; however, to isolate operating costs for sour versus sweet for each plant was not practical. Using the ratio approach provides a conservative estimate of the processing costs for sour gas.

To obtain an estimate of sour gas processing expenditures at a provincial level, the average expenditure data per unit of marketable gas production for the 17 plants were used. The average was adjusted based on published averages or unit operating cost rates (UOCR) produced by Alberta Energy to take into account the different sour gas plant types.[16] Again, as plants designated as a sour facility may also process sweet gas, only the proportion of operating expenditures that could be attributed to processing sour gas was included in the expenditure estimate, which was in turn used to calculate the economic impacts.

Sour gas processing occurs in over 50 municipalities throughout Alberta, about 80 per cent of which is west of the fifth meridian. About 200 sour gas plants had marketable natural gas deliveries of 60 10^9 m^3 in 2000. However, it was estimated that sweet gas accounted for about 35 per cent of natural gas production from these plants. When this sweet gas processing is removed, the total sour gas production falls to 40 10^9 m^3, about 30 per cent of total marketable natural gas deliveries in 2000.

Gas plant operators, in response to a telephone survey, provided information describing the inputs (goods, services and labour) and the expenditure patterns of their facilities. Their responses indicated that operating costs for the plants were split roughly 27 per cent for wages and salaries and 73 per cent for goods and services. Electric power, industrial

[15] If it is more economic to have the sweet gas processed at the sour versus a sweet plant, there would be an incremental benefit, but it would likely be small and it would be difficult to calculate.

[16] Alberta Energy, Designated and Plant Type Unit Operating Cost Rates, 2000. There are three sour gas plant types defined by Alberta Energy: Type 3 is dry gas with sulphur removal, Type 4 is wet gas with sulphur removal, and Type 5 is dry/wet gas with sulphur recovery.

chemicals, and professional services represented over 60 per cent of the goods and services expenditures made by the plants.

Only those plant employees residing in the municipality were included in the local spending estimate for each plant. The percentage of wages and salaries paid to local residents relative to total wages and salaries for the plants was estimated at 31 per cent for RockyView/Foothills, 55 per cent for Clearwater County, and 41 per cent for Saddle Hills County. Goods and services purchases (expressed in purchaser's prices) captured locally ranged from 12 per cent in RockyView/Foothills to about 26 per cent in Clearwater County and roughly one-quarter for Saddle Hills County. The categories of local content primarily included business services, repair construction, fuel, municipal taxes, and lease payments. A proportion of the transportation, wholesale and retail margins also remain locally, which are calculated automatically by the model when it converts purchaser's prices into producer's prices.

The economic impacts associated with sour gas processing were estimated using custom runs of the 1998 Input-Output Impact Model for each of the municipal areas and the province.

3.6 Provincial Royalties from Sour Gas Production

The total value of natural gas and natural gas liquids royalties collected by the Government of Alberta in 2000 was $5.75 billion. While sour gas accounted for roughly 30 per cent of marketable gas production in Alberta, its share of the total royalty value was less due to the higher capital and processing costs associated with sour gas production, the deep gas royalty holiday more prevalent with sour gas, and the portion of liquids associated with sour gas production. Alberta Energy took each of these factors into account to estimate the natural gas, natural gas liquids and sulphur royalty attributed to sour gas production, which it calculated at $1.52 billion, or 26 per cent of the total.

The total freehold mineral tax collected in 2000 was $237 million, split roughly two-thirds for natural gas and natural gas liquids and one-third for crude oil and solution gas.[17] To calculate the amount attributable to sour gas production, the ratio of sour gas and liquids royalties to total natural gas and liquids royalties was applied to the freehold mineral tax for natural gas and natural gas liquids, to obtain an estimate of $41 million.

3.6.1 Allowable Costs for Sour Gas Processing

To take account of the difference in allowable costs for processing sour gas, it was necessary to determine the ratio of sour gas to sweet gas processed by the sour gas plants. It was determined that 80 per cent of the gas plant capital costs and 66 per cent of the gas plant processing fees are attributable to sour gas processing.

3.6.2 Deep Gas Royalty Holiday Program

To account for the credit available under the Deep Gas Royalty Holiday Program, it was necessary to determine the percentage of total wells subject to the program in 2000 that were sour gas wells. In all, there were roughly 250 wells in the program; with about one-third of these were sour gas wells (EUB). To allocate the value of the credit associated

[17] Alberta Energy, Tenure Division, personal communication, 2003.

with sour gas, the total provincial credit was prorated according to the volumetric proportion from each product.

3.6.3 Natural Gas Liquids Royalty Attributable to Sour Gas

The total volumes of liquids from sour gas field plants is available from EUB records, this information was used by Alberta Energy to estimate the sour gas portion of the royalty on natural gas liquids (NGL – pentane, propane, butane, ethane). The ratio of NGL production (for each product) from sour gas field plants to total NGL production (royalty liable volumes) is shown in Table 4.

Table 4. Sour gas share of NGL production (10^6 m^3)

	Pentane	Propane	Butane	Ethane
Sour gas total–natural gas field plants	3.7	1.3	0.8	1.3
Total royalty liable volume	7.3	4.9	3.6	3.0
Overall sour gas percentage	51%	27%	22%	43%

Source: EUB.

All royalty amounts were determined from average Crown interest and royalty rates that apply to the production year for 2000 (including information amendments for production submitted to Alberta Energy up to December 2002).

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Appendix 4 Municipal Net Financial Benefit—Methodology, Analysis, and Assumptions

This appendix examines the methodology, analysis, and assumptions used to determine the direct net financial benefit to municipalities impacted by sour gas development.

1 Municipal Revenues from Sour Gas Development

Municipal tax revenues associated with sour gas development are collected on three types of nonresidential assessment: machinery and equipment (M&E), buildings and structures (B&S), and linear assessment. Wells and pipelines constitute the bulk of the sour gas assessment. Assessment for wells and pipelines is calculated using the cost approach and is not determined by estimations of market value. Sour gas processing plants are assessed as M&E and B&S. Nonsurface facilities fall under linear assessment.

Municipal Affairs provided information on linear assessment, as it performs the assessment calculation for wells and pipelines. The municipality, however, retains control over the tax rate applied to linear assessment. Hence, the revenue collected is based on Municipal Affairs' determination of assessment and the municipality's determination of the tax rate. Municipal Affairs was able to identify those facilities associated with sour gas, which allowed the calculation of sour gas revenue for each municipality.

For M&E and B&S, the municipality determines both the assessment and the tax rate. The municipalities provided information on M&E and B&S assessment/revenues associated with sour gas development. M&E and B&S assessment information was not available for Rocky View and therefore had to be estimated based on information obtained from the other three municipalities. Oil and gas assessment accounted for approximately 90 per cent of nonresidential assessment in Saddle Hills County. In Clearwater County, oil and gas assessment accounted for approximately 75 per cent of M&E and B&S assessment and close to 100 per cent of linear assessment.

Once assessment information was collected, tax revenue was calculated by simply applying the appropriate municipal rate to the assessment category. The calculation of sour gas revenue by assessment category for each of the four municipalities is shown below in Tables 1 through 4. (Total refers to total tax revenue plus grants and other municipal revenues.)

Table 1. Municipal revenues related to sour gas – MD of Rocky View

	Mill rate	Total ($000)	Assessment sour gas ($M)	Sour gas ($000)
Residential and farmland	3.2	8 956	n/a	0
Nonresidential (B&S & other)	3.2	625	72	232
M&E	3.2	764	238	764
Linear	3.1	1 072	186	575
Grants	n/a	2 274	n/a	0
Other revenue	n/a	10 715	n/a	10*
Total	n/a	24 406	496	1 581, or 6%

*Oil well drilling tax revenue attributable to sour gas—this tax is calculated independently of the assessment base.
Sources: Alberta Municipal Affairs, MD of Rocky View, and EUB.

Table 2. Municipal revenues related to sour gas – MD of Foothills

	Mill rate	Total ($000)	Assessment sour gas ($M)	Sour gas ($000)
Residential and farmland	3.8*	6 825	n/a	0
Nonresidential (B&S & other)	6.7	1 236	15	101
M&E	5.8	775	72	414
Linear	6.7	1 204	66	440
Grants (transportation)	n/a	1 568	n/a	0
Other grants	n/a	457	n/a	0
Other revenue	n/a	4 161	n/a	50**
Total	n/a	16 226	153	960, or 6%

* Mill rate for farms 7.0.

** Oil well drilling tax revenue attributable to sour gas—this tax is calculated independently of the assessment base.

Sources: Alberta Municipal Affairs, MD of Foothills, and EUB.

Table 3. Municipal revenues related to sour gas – Clearwater County

	Mill rate	Total ($000)	Assessment sour gas ($M)	Sour gas ($000)
Residential and farmland	3.6	1 632	n/a	0
Nonresidential (B&S & other)	4.4	625	51	286
M&E	4.3	3 362	456	1 967
Linear	4.4	5 321	430	1 903
Grants (transportation)	n/a	4 036	n/a	0
Other grants	n/a	725	n/a	0
Other revenue	n/a	2 500	n/a	62*
Total	n/a	18 201	937	4 156, or 23%

* Oil well drilling tax revenue attributable to sour gas—this tax is calculated independently of the assessment base.

Sources: Alberta Municipal Affairs, Clearwater County, and EUB.

Table 4. Municipal revenues related to sour gas – Saddle Hills County

	Mill rate	Total ($000)	Assessment sour gas ($M)	Sour gas ($000)
Residential and farmland	3.6*	501	n/a	0
Nonresidential (B&S & other)	9.5	364	13	157
M&E	9.5	2 113	94	886
Linear	9.5	3 963	127	1 198
Grants	n/a	1 939	n/a	0
Other revenue	n/a	1 029	n/a	16**
Total	n/a	9 909	233	2 257, or 23%

* Mill rate for farms 8.0.

** Oil well drilling tax revenue attributable to sour gas—this tax is calculated independently of the assessment base.

Sources: Alberta Municipal Affairs, Saddle Hills County, and EUB.

2 Municipal Costs from Sour Gas Development

In the calculation of municipal costs (expenditures) attributable to sour gas activity, road costs and expenditures for emergency planning are the primary factors, with road expenditures representing the majority of costs.

Total road expenditures were obtained from the 2001 municipal financial statements of the municipalities and in some cases were provided directly by the municipalities themselves so that road expenditures could be explicitly identified rather than included along with other infrastructure costs, as is often done in the financial statements. Total

expenditures were in turn split into operating (maintenance and repair) and capital (road construction and upgrades) expenditures. The identification of the sour gas industry component of these costs relied on a similar approach across the municipalities, which was adapted to include specific information and assumptions provided by officials in each jurisdiction.

2.1 MD of Rocky View

For Rocky View, municipal officials indicated that about 75 per cent of construction expenditures were associated with paved roads and about 25 per cent with gravel roads. Maintenance expenditures were divided equally between paved and gravel roads.

About 35 to 40 per cent (assumed at 37.5 per cent) of municipal roads were identified as being used by trucking/industry, and about 15 to 20 per cent (assumed at 17.5 per cent) of municipal roads were identified as being used by the oil and gas industry. Of this, about 15 per cent of the roads used by oil and gas industry activity (or 2.6 per cent of all roads) was associated with sour gas industry activity (identified from the proportion of sour wells among all wells).

Of the 2.6 per cent of roads used by the sour gas industry, 75 per cent of the costs for the paved roads were associated with industrial trucking, and 90 per cent of the costs for the gravel roads were associated with industrial trucking (in this case, sour gas traffic).

Finally, some $16 000 was estimated as expenditures for the review of sour gas emergency response plans and other disaster review for the industry, based on the information that it requires one-quarter of the time of the disaster review administrator for the district (a general estimate of their overhead was provided). A list of the costs is in Table 5.

Table 5. Sour gas development costs – MD of Rocky View ($'000)

Total road/infrastructure cost	14 567
Operating	7 359
Capital	7 205
Sour share of road/infrastructure cost[1]	305
Operating	158
Capital	147
Sour share of emergency response planning and field inspections[2]	16
Sour share of assessment of oil and gas properties[3]	n/a
Total sour gas development costs	**321**

[1] Road costs for all industry based on assumptions made related to industry's use of paved and gravel roads and the maintenance and capital costs associated with industry's use: oil and gas at 18% of industry use and sour gas at 15% of oil and gas use.
[2] 25% of the time of one full-time staff..
[3] n/a
Sources: MD of Rocky View and EUB.

2.2 MD of Foothills

Information from the municipality suggested that about 3 per cent of municipal road expenditures are directly set aside for industry/heavy trucking-specific roads.

To identify the proportion of direct costs attributable to oil and gas activity, the proportion of oil and gas industry labour force to all industry labour force (Statistics Canada, Census 2001) (about 35 per cent) for the MD was used.
The proportion of sour wells among all nonabandoned oil and gas wells in the MD (about 31 per cent) was used to calculate the proportion of direct oil and gas industry road costs attributable to the sour gas industry.

However, these "direct" expenditures on industry were not the only road expenditures incurred as a result of industry activity. It was also suggested that some 75 per cent of municipal roads generally dealt with some type of truck traffic. Given the effort invested by the MD to separate industry traffic from the rest of the municipal road system, only half, or 37.5 per cent, was assumed to experience heavy truck (i.e., industry) traffic.

The overwhelming share of roads in the MD was gravel (with about 1200 km of gravel roads out of a total of 1600 km of developed roads). Information provided by Alberta Transportation indicates that about 90 per cent of the costs for gravel roads could be associated with truck traffic activity when the roads dealt with such activity.

Therefore, 90 per cent of the costs associated with 37.5 per cent of the roads in the MD were indirectly attributable to industry activity, by assumption. Using the same proportions used in the calculation of direct costs, some 35 per cent of the indirect industry expenditures were associated with oil and gas activity, and 31 per cent of this with sour gas industry activity.

The sum of both the direct and indirect road operating and capital expenditures represents the total road expenditure related to sour gas.

The assessment of oil and gas properties was another cost identified by the district, in the order of $18 000 per year, with $10 026 of this attributable to sour gas based upon its proportion of total oil and gas assessment. Also included as a measure of cost was the time required of staff in review of sour gas emergency response plans, estimated as requiring one-quarter of the time of three full-time staff with an average wage of $50 000 per year. A list of the costs is in Table 6.

Table 6. Sour gas development costs – MD of Foothills ($'000)

Total road/infrastructure cost	9 757
Operating	7 934
Capital	1 824
Sour share of road/infrastructure cost[1]	391, or 4.5%
Operating	318
Capital	73
Sour share of emergency response planning and field inspections[2]	38
Sour share of assessment of oil and gas properties[3]	10
Total sour gas development costs	**439**

[1] Industry indirectly responsible for approximately 37% of road costs and 3% of direct road costs: oil and gas at 35% of industry use and sour gas at 31% of oil and gas use.
[2] 25% or the time of three full-time staff at an average salary of $50 000 each.
[3] Total cost $18 000; sour share assumed at 56%.
Sources: MD of Foothills, and EUB.

2.3 Clearwater County

Details on the road budget were obtained from municipal personnel rather than from the 2001 financial statement. They better isolated road expenditures from the larger infrastructure budget for the municipality.

To allow for the isolation of all industrial road costs, officials in the county divided the road budget into five different categories of expenditure (shown below) and provided information to allow for the determination of industry cost in each. The five categories were

- gravel – one-third of the roads are gravelled every year: 750 km at $1600/km
- gravel reconstruction – 17.5 km at $75 000/km
- base paving (construction) – 9 km at $170 000/km
- asphalt overlay – done every 15 years if industrial use, every 17-20 years if no industrial use: 9 km at $98 000/km; and
- chip seal (maintenance) – lasts 3 years with industrial use and 5-7 years without: 30 km at $10 500/km.

For gravel maintenance, gravel reconstruction, and base paving, municipal personnel indicated that each category of expenditure could be reduced by one-third without the existence of industry traffic. (Base paving was the only category of road expenditure as representing any sort of new construction activity. Thus, only base paving was included in the measurement of capital road expenditures.)

For asphalt overlay, municipal personnel indicated that currently every paved road must be overlaid within 15 years. Without industry traffic, that period could be extended to 17-20 years. For chip seal expenditures, it was indicated that chip seal only lasts about 3 years with industry traffic, but could probably last as long as 5-7 years without. Information was provided as to the typical amount in kilometres of road subject to asphalt overlay and chip seal per year, and the expenditure for each activity per kilometre. Given the difference in depreciation rates for asphalt overlay and chip seal roads between the current case and the scenario without industry activity, it was possible to calculate the cost attributable to industry in the way of expenditures per year for each.

The proportion of oil and gas industry labour force out of all industry labour force (49 per cent) was used to calculate the oil and gas share of all industry road costs. From there, the sour proportion of wells (7 per cent) was used to calculate the sour share of oil and gas expenditures. About 7 per cent of 49 per cent, or 4 per cent, of industry road costs were then attributable to the sour gas industry.

Expenditures for the review of sour gas emergency response plans and other protective services were estimated to be 16 per cent of the administrative budget, or around $200 000. Finally, industry was identified as generating revenue redistributed to other municipalities in the amount of $215 000, which was treated as a cost by the county. The portion of revenue attributable to the sour gas industry was used to identify the sour gas share of this cost. A list of the costs is in Table 7.

Table 7. Sour gas development costs – Clearwater County ($'000)

Total road/infrastructure cost	6 835
Operating	4 700
Capital	2 135
Sour share of road/infrastructure cost[1]	81
Operating	55
Capital	26
Sour share of emergency response planning and field inspections[2]	200
Sour share of tax transfers to other municipalities[3]	51
Total sour gas development costs	**332**

[1] Road costs for all industry based on assumptions made related to industry's use of paved and gravel roads and the maintenance and capital costs associated with industry's use: oil and gas at 49% of industry use and sour gas at 7% of oil and gas use.
[2] Assumed at 16% of municipality's administration budget.
[3] Total cost provided by municipality was $215 000; sour share assumed at roughly 24%.
Sources: MD of Rocky View and EUB.

2.4 Saddle Hills County

Municipal officials provided the road budget and its operating and capital components for Saddle Hills County.

In this case, it was possible to explicitly identify the approximate size of road expenditures required as a result of oil and gas activity: $3.5 million. (The same proportion of operating to capital expenditures seen in the larger budget was assumed to hold for these oilfield road expenditures.)

The ratio of sour wells among all nonabandoned wells was used to identify the portion of oil and gas road expenditures associated with sour gas activity alone (17 per cent).

The other costs attributable to the sour gas industry outside of road costs were

- expenditures incurred for the salary of the technical services coordinator, a full-time position devoted exclusively to serve as a liaison to the oil and gas industry;
- expenditures for protection equipment (goggles, oxygen tank) and training in H_2S safety and protection for staff; and
- time required for the review of sour gas emergency response plans (identified as 2 hours per week at a wage of about $30/hour).

A list of the costs is in Table 8.

Table 8. Sour gas development costs – Saddle Hills County ($'000)

Total road/infrastructure cost	4 979
Operating	1 550
Capital	3 429
Sour share of road/infrastructure cost[1]	608
Operating	189
Capital	419
Sour share of emergency response planning and field inspections[2]	18
Sour share of training and protection equipment[3]	11
Total sour gas development costs	**637**

[1] Road costs associated with oil and gas provided by municipality; sour gas costs estimated at 17% of oil and gas use.

[2] Includes ERP and field inspection costs provided by the municipality, as well as the salary costs for 17% of the time of technical services coordinator.

[3] Includes H_2S training for staff and the cost of protection equipment for field staff.

Sources: Saddle Hills County and EUB.

3 Municipal Net Financial Benefit

The calculation of the net financial benefit for each municipality is calculated by taking the difference between the municipal financial benefit and the total municipal cost or expenditure, shown in Table 9.

Table 9: Summary of municipal net financial benefit

	Rocky View	Foothills	Clearwater County	Saddle Hills County
Estimated sour gas revenues	$1 581 000	$960 000	$4 155 000	$2 257 000
Estimated sour gas costs	$321 000	$439 000	$332 000	$637 000
Net financial benefit	$1 260 000	$521 000	$3 824 000	$1 621 000

Source: EUB.

The calculation of the possible change in tax rates if the sour gas industry was not present in each of the municipalities was based on two assumptions. The first was that each municipality would need to recover only the net financial benefit (net of budget costs) the industry had contributed to revenue. The second was that the municipalities will aim to increase rates for every category of assessment proportionally so as not to have to increase rates on the nonresidential assessment alone.

Another way to think about the relative importance of the municipal net financial benefit associated with sour gas is to examine what impact the sour gas industry has on reducing the municipal tax rates. As an illustration, the sour gas assessment for each municipality was removed from the municipality's assessment base to determine the impact on the residential tax rate. The tax rates were recalculated to determine the increase in taxes that would be needed to generate an additional amount of revenue equivalent to the municipal net financial benefit.[18] In other words, without the sour gas industry, both revenues and costs would be lower for each municipality, and the amount of additional revenue that would need to be raised is determined by the extent revenues exceed costs. Tax rates would need to be increased to offset the lost sour gas assessment, but only to the extent that the "net" revenue shortfall is recovered. To make the calculation, it was assumed that

[18] The effect on tax rates is likely understated given that adjustments should also be made to the population base and in turn the amount of residential assessment to reflect a difference in population if the sour gas industry were not present. This adjustment was not made in the interest of keeping the example as simple as possible.

the ratio between residential tax revenues and nonresidential tax revenues would remain the same, i.e., increase proportionally. This simple exercise is only provided for illustrative purposes, it does not adjust for changes to the population base in the absence of the sour gas industry, nor does it incorporate any dynamic impacts that may result in the absence of the sour gas industry; for example, it would not account for increased housing construction in an area where sour gas setbacks are currently restricting residential development.

Table 10 gives the data used to calculate the change in the residential mill rate for each municipality if sour gas facilities were removed from the municipality's tax base.

Table 10. Hypothetical impact on residential taxes without sour gas assessment

	Rocky View	Foothills	Clearwater	Saddle Hills
Residential assessment ($M)	2 790	1 667	453	80
Nonresidential assessment ($M)	844	500	2 125	680
Nonresidential assessment less sour gas ($M)	347	347	1 188	448
Revenues from residential assessment ($000)	**8 956**	**6 825**	**1 632**	**501**
Revenues from nonresidential assessment ($000)	2 667	3 215	9 308	6 440
Total revenues, residential & nonresidential ($000)	11 623	10 040	10 940	6 941
Net cost due to sour gas industry ($000)	321	439	332	637
New total revenue requirement ($000)	11 302	9 601	10 608	6 304
New revenues from residential assessments ($000)	**10 070**	**7 213**	**2 529**	**667**
Additional residential revenues required ($000)	1 114	387	897	166
% increase in residential mill rate/revenue requirement	**12%**	**6%**	**55%**	**33%**
Number of private households (2001 census)	9 780	5 770	4 180	945
Increase in residential taxes per household	**114**	**67**	**215**	**176**

Sources: EUB, MD of Rocky View, MD of Foothills, Clearwater County, and Saddle Hills County.

4 Bibliography

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Alberta Transportation. Personal Communications, Edmonton, Alberta, 2003.

Clearwater County. Personal Communications and Financial Information Return for the Year Ending December 31, 2001. Heywood Holmes & Partners LLP. Rocky Mountain House, Alberta, 2002 and 2003.

Municipal District of Rocky View. Personal Communications and 2001 Audited Financial Statements. PricewaterhouseCoopers LLP. Calgary, Alberta, 2002 and 2003.

Municipal District of Foothills. Personal Communications and Financial Statements for the Year Ended December 31, 2001. Young Parkyn McNab LLP. High River, Alberta, 2002 and 2003.

Saddle Hills County. Personal Communications and Consolidated Financial Statements for the Year Ended December 31, 2001. Taylor McComb. Spirit River, Alberta, 2002 and 2003.

Appendix 5 Impact of Sour Gas Development on Local Residents: Interview Results

The I-79 study provides a quantitative analysis of the net financial benefit of sour gas development to municipalities. However, while a particular county or MD may receive an economic benefit from sour gas development, the net financial benefit that each individual within that municipality receives from sour gas development will vary depending on their location, their unique circumstances, their experiences, and their values. Some local residents identify costs and benefits that they associate with sour gas development that are difficult to quantify, but are important to acknowledge. The I-79 committee chose to incorporate these impacts in a qualitative manner within the study.

Methodology

Anecdotal data were collected through a series of interviews with residents of the four municipal areas that are the focus of the I-79 study and with members of the Stoney First Nations Band. In each municipality, five to ten residents were interviewed in the form of either an individual interview or in a group setting. The I-79 Committee acknowledges that the number of people interviewed in each area does not constitute a sufficient sample for statistical purposes. The intention was to obtain a cross-section of views in the communities regarding sour gas development; it was not meant to support a statistical analysis. Rather, individuals and groups were engaged in a discussion of how sour gas development has affected their lives, both individually and as a member of a community.

In each area, names of potential interviewees were provided by I-79 Committee members and other local contacts who were familiar with the issues and with the community. The attempt was made to obtain the views of individuals with a mixture of backgrounds and experiences. Participants can be generally classified into the following groups:

- residents who make their living in the agricultural industry;
- residents who live in rural areas and commute to urban areas for employment;
- residents who live in rural areas and work part time or full time for the sour gas industry;
- residents who live in smaller urban centres and feel the impacts, positive and negative, of an established sour gas industry; and
- Aboriginal residents of an established First Nation reserve.

The format of the interviews varied depending upon the interviewee's preference to be interviewed either in a one-to-one format or in a group and on the physical location of the participants. Specifically, the interviews occurred in the following manner:

- MD of Rocky View – Interviews were conducted with five residents, whose names were provided through the Airdrie and Area Public and Petroleum Producers Awareness Alliance (APPA). Additionally, a group interview was conducted with six members of the Calgary North H2S Action Committee (CNH2SAC).

- MD of Foothills – Individual interviews were conducted with six area residents. In addition, data are included from a survey conducted by an energy company with a gas processing facility in the MD of Foothills.

- Clearwater County – A group interview was conducted with ten members of the Sundre Petroleum Operator's Group (SPOG). The SPOG organization contains

representation from residents of both Clearwater County and the County of Mountainview. Therefore, the results from this interview refer to both municipalities.

- Saddle Hills County – Individual interviews were conducted by telephone with six county residents.

- Stoney First Nation – A group interview was conducted with members of the Stoney First Nation Oil and Gas Committee.

Members of SPOG chose to discuss issues as a group, and the subject matter was divided into four sections: economic impacts, social/community impacts, safety and quality-of-life impacts, and human and animal health.

The CNH2SAC also participated in an interview as a group. This group discussed many of the same issues as the other groups and individuals; however, they categorized them in a different manner. The CNH2SAC identified quality-of-life issues and categorized them on the basis of how easily they believed they could be quantified. For example, the out-of-pocket cost for an individual or group to attend an EUB hearing on a particular matter was deemed to be "determinant" and readily quantifiable, whereas the loss of rural solitude or disturbance and displacement of wildlife were deemed to be costs that were more difficult to quantify.

Interview Results

The interview responses are presented in the following table according to the areas of impact identified by the I-79 Committee: monetary, safety, environmental, lifestyle, human and animal health, relations with the sour gas industry and the EUB, and social and community.

Research Studies – Health Impacts

The following is a list of some of the research that has been completed or is underway in Alberta around the possible health effects associated with emissions from sour gas facilities:

Alberta Environment Council 92-P2. Effects of Acid Forming Emissions in Livestock. Proceedings of an International Workshop, November 18-19, 1986.

Clean Air Strategic Alliance (CASA). Animal Health Project Team, Final Report and Recommendations, March, 2003.

Mostrom, M.S., C.A.J. Campbell and R.W. Coppock. Use of Livestock as Monitors of Environmental Health Following a Petroleum Pipeline Break. Environmental Toxicology Research, Alberta Environmental Centre, Vegreville, Alberta.

Scott, H.M. Effects of Air Emissions from Sour Gas Plants on the Health and Productivity of Beef and Dairy Herds in Alberta, Canada. Ph.D. Thesis. University of Guelph, Guelph, Ontario, 1998

Waldner, C.L., C.S. Ribble, and E.D. Janzen. Evaluation of the Impact of a Natural gas Leak from Pipeline on Productivity of Beef Cattle. Journal of Veterinary Medicine Today, Vol. 212, No. 1, January 1, 1998.

Waldner, C.L. Beef Herd Health and Productivity and Exposure to the Petroleum Industry in West-Central Alberta. Ph.D. Thesis. University of Saskatchewan, Saskatoon, Saskatchewan, 1999.

Waldner, C.L., C.S. Ribble, E.D. Janzen and J.R. Campbell. Associations Between Oil and Gas Well Sites, Processing Facilities, Flaring and Beef Cattle Reproduction and Calf Mortality in Western Canada. Preventative Veterinary Medicine, 50: 1-17, 2001a.

Waldner, C.L., C.S. Ribble, E.D. Janzen and J.R. Campbell. Associations Between Total Sulfation, Hydrogen Sulphide Deposition, and Beef Cattle Breeding Outcomes in Western Canada, Preventative Veterinary Medicine, 50: 19-33, 2001b.

Waldner, C.L. Monitoring Beef Cattle Productivity as a Measure of Environmental Health. Environmental Research Section A, 86: 94-106, 2001c.

Western Interprovincial Scientific Studies Association (WISSA). Western Canada Study on Animal and Human Health Effects Associated with Exposure to Emissions from Oil and Natural Gas Field Facilities. Ongoing.

Appendix 5. Interview Results

Nature of Concern	Issue Description	Communities Interviewed				
		Rocky View	Foothills	Clearwater County	Saddle Hills County	Stoney First Nation
Monetary						
Time	The time required to deal with the sour gas industry.	Time invested in educating themselves about the sour gas industry, preparing and participating in EUB hearings, and attending operator information meetings, etc.	Time invested in educating themselves about the sour industry, in EUB hearings, in operator information meetings, etc. Time invested in monitoring the sour gas activity in their area	Time spent dealing with incompetent operators and taking complaints to the municipal level Time invested in educating themselves about the sour industry, in EUB hearings, in operator information meetings, etc.	Not mentioned	Not mentioned
Compensation	Issues regarding the compensation paid by sour gas operators to landowners for access to their property.	Compensation, where it is provided, is appreciated by those receiving it Compensation is not always paid to everyone living with the problems of sour gas Compensation does not reflect the value of land Compensation does not remunerate for hours spent dealing with industry issues Compensation cannot offset the quality of life impacts of the industry	Complained that landowners adjacent to sour gas facilities do not receive compensation	Not mentioned	Compensation is generally fair, but it is not regarded to be as generous as it could be, i.e., at least it should keep pace with inflation	$70 million in royalty payments received annually by the Stoney Band from the oil and gas industry. Percentage attributable to sour gas unknown
Property Value and Land Use	The financial impacts on land values resulting from proximity to sour gas facilities. Also, the limitations on agricultural or residential development imposed from sour gas setbacks or industrial zoning.	Belief that property value decreases due to proximity to sour gas activity Financial costs are imposed because of sour gas setbacks (mostly in preventing land development due to an inability to subdivide land, also land taken out of agricultural production, etc.)	Belief that sour gas facilities are only a negative on land value One resident would not put any more money into their property and was considering selling their acreage as a result	Property values were believed to have increased as a result of additional competition for the land base generated by industrial development (including sour gas development) Rising cost of purchasing land for agricultural purchases Sour gas setbacks were criticized for imposing restrictions on other land development and property subdivision	Property values believed to have remained flat or risen as a result of the industry One resident interviewed believed land values are negatively impacted Lack of proper weed control, hassles of farming around facilities and concern about the indirect effects of the industry on livestock were primary land-use issues discussed	Not mentioned
Out-of-Pocket Costs	Quantifiable costs born by residents as a result of sour gas development in their area.	Fees for professional legal assistance during disputes with industry† Increased property insurance because of location in a more corrosive environment and potential absence in the event of forced evacuation Increased property taxes because of greater road maintenance and decreased property value Veterinarian costs to establish baseline health of livestock, preventative programs and regular updates Reduced vehicle life due to poor road conditions The Calgary North H2S Action Committee has compiled a comprehensive summary of costs incurred by the group to participate in an EUB hearing regarding a gas well in their area (1720 person hours) † There is an EUB provision to apply for an advance on costs for a dispute brought in front of the EUB	Costs to attend hearings and purchase reports Costs of moving livestock during a pipeline break Cracks in the foundation of one resident's home following seismic activity	Not mentioned	Not mentioned	Not mentioned

Appendix 5. Interview Results

Nature of Concern	Issue Description	Communities Interviewed				
		Rocky View	Foothills	Clearwater County	Saddle Hills County	Stoney First Nation
Safety	The risks and dangers of living near a sour gas facility and the operating practices of sour gas operators	Safety is a primary concern All residents interviewed were aware of the emergency response plans of the companies in their area Past incidents (e.g., a pipeline leak) have increased the level of concern considerably regarding the effectiveness of the emergency response plans Concerns also centre around the competency of company and contract staff (lack of continuity; disrespect for landowners and their property) Some suggested that all residents be equipped with sour gas detection and respiratory equipment Suggested that hands-on safety training procedures should be provided to local residents Also called for the construction and maintenance of egress roads in the event of an emergency	Concerns about safety were exacerbated by a sour gas pipeline leak in the spring of 2002. A resident stated the emergency response plan was a failure as the call system did not work properly and one resident's property was not known to company representatives Sour gas activity should not be permitted so close to residential properties Concern that smaller companies involved in the sour gas industry sacrifice safety for monetary return	Safe operation of sour facilities is always a concern; however, as the level of familiarity in the community with emergency response plans and the sour gas industry increases with no major incidents, anxiety levels have been reduced New residents generally have more concerns with respect to safety issues The community would like a clearer picture of what actions to take after an incident; for example, what process is in place for restoring and compensating landowners and residents in the aftermath of an incident	Generally satisfied with the safety plans and procedures of operators Some residents, after experiencing the implementation of the ERPs, noted that they were satisfied with the results	As 83% of the Stoney Band speak their native language at home, a language barrier exists, which the Stoney Band would like resolved with translations of the ERPs into Stoney and for a translation to be transmitted over the radio to alert residents to any incidents and provide instructions for action
Environmental	The effects of the sour gas industry on air and water quality, noise, visual obstructions, property and traffic disturbances, etc.	Noise (from compressors, processing plants and vehicles) Air (odours, dust and residue) Water (concern about contamination, competition for water sources, experiences where water sources have disappeared or turned black, corrosion in pipes and faucets, well damage from seismic activity, concern about possible redirection of aquifers) Disturbance and displacement of wildlife	Concern over water quality (contamination) Air (odors and smoke from gas plant) Noise (drilling & traffic, back up alarms) Light pollution (night security lights) Increase in traffic Displacement of wildlife Rather than use Gross Domestic Product (GDP) as an indicator of growth, society should implement the Genuine Progress Indicator, which measures economic activity along with social costs and ecological costs	Visual obstruction Noise Odours Traffic volumes and irresponsible driving Weeds are a problem in agricultural areas due to the amount of equipment and people moving from one area to another	Odours – several residents interviewed expressed concern about odours from the sour gas industry. Some experienced constant odours for years before action was taken to alleviate them; while others experience them sporadically depending on wind direction Noise (mostly from compressors). Some companies have installed mufflers or other improvements to reduce the noise from compression units Traffic – increased volume and traffic travelling at high speeds cause safety concerns	Concerned about the quality of their air, water and soil and would like to have a comprehensive analysis completed
Lifestyle	The sour gas industry's effect on resident's lifestyle	Loss of rural solitude Stress and fear associated with the unknown and the unpredictable Energy facilities provide targets for vandalism and terrorism Concern about security – unfamiliar people in fields and on roads	Stress and fear associated with not trusting local sour gas operators and the unknown human health effects of prolonged exposure to low level emissions Mental anguish, no peace of mind Relationship difficulties caused by stress over the unknown and the time commitment necessary to monitor developments in the sour gas industry Loss of rural solitude Inability to observe the night sky	Visual obstruction, noise, odours are the factors that have negative lifestyle impacts	Loss of peace and serenity	Frustration over the lack of understanding of their culture and lifestyle by representatives of the energy industry Industry representatives not always aware of the location of sacred lands and believe that band elders should be hired by oil and gas companies to inform them of where these lands are Notification of work needs to be provided in person according to Stoney culture, whereas, in practice, notification is often provided in writing

Appendix 5. Interview Results

Nature of Concern	Issue Description	Communities Interviewed				
		Rocky View	Foothills	Clearwater County	Saddle Hills County	Stoney First Nation
Human and Animal Health						
Current Experiences	The perceived health effects attributable to industry activity, either in people or livestock	Industry should use state-of-the-art technology to alleviate health concerns Concern about the amount of flaring in the area One resident has been experiencing breathing problems and has noticed a constant film on the windows of their residence One commented that government and industry have a vested interest in downplaying evidence of health effects on humans, animals and plants One resident stated they are not currently experiencing any difficulties with livestock	One resident expressed concern over the large number of students at Millarville school with asthma and other breathing difficulties Health effects related to stress associated with dealing with the industry Some residents interviewed want to be assured that industry is using the most up-to-date technology to minimize emissions and prevent accidents Concern over the health of livestock	Concern over the amount of flaring that occurs. Flaring is outdated technology, produces questionable emissions, and is a waste of resources and money A credible scientific study on animal health was completed in the SPOG area and has been helpful in separating fact from opinion regarding the effects on herds from exposure to sour gas	No health complaints for people or livestock from the interviewees Flaring is a concern, however, they believe industry is starting to apply improved, alternative methods, such as incineration	Members are concerned about the high incidence of asthma and gallstones in their population Concerns about the quality of water in their ponds, streams and rivers and the possible health effects
Concern about the Future	The unknown long-term effects of sour gas emissions on human and animal health	Concern over the human and livestock health effects from exposure to long-term and short-term low-level concentrations Concern over the cumulative effects of a multitude of emissions and the effects of the unknown chemicals contained in raw natural gas Health costs likely to rise for residents within emergency planning zones (EPZs) as privatization of health puts more cost discretion in the hands of the caregivers	Concern over the effects of contaminated groundwater Concern over the effects of living near a plant that emits 2 tonnes of sulphur a day Would like the EUB to undertake a long-term health study on the long-term effects of exposure to nontoxic levels of sour gas Would like industry operators to contribute more funds to exploring the potential health effects caused by sour gas operations	Lack of information with respect to the long term health effects of emissions creates anxiety Recommend that a long-term rigorous scientific study should be undertaken to help residents distinguish fact from opinion in dealing with these issues	Concern about the unknown long-term health effects of sour gas emissions One resident commented that the goal of the industry should be 0% emissions	Not mentioned
Relations with the Sour Gas Industry and the EUB						
Consultation Process	How residents view the relationship between themselves and the sour gas operators in their area	Degree of satisfaction during pre-development stage varies substantially by company Consultation does not go beyond the initial well site (to deal with compressors, additional wells) No consultation unless they are drilling on your land One resident was given a letter while on vacation that gave 14 days to object to the development Residents are looking for earlier, more comprehensive communication	Lack of trust between residents and sour gas industry operators Lack of accountability by industry has resulted in no trust and no relationship Want industry to be up front, honest and accountable	Not mentioned	A few companies participated in a seminar at the local hall, which helped residents who felt they had not been consulted about a particular project Most major companies seem to understand the importance of proactive public consultation so that people feel they have been dealt with fairly	Frustrations exist over the lack of effective communication from industry representatives

Appendix 5. Interview Results

Nature of Concern	Issue Description	Communities Interviewed				
		Rocky View	Foothills	Clearwater County	Saddle Hills County	Stoney First Nation
Ongoing Operations	Comments regarding the care and sensitivity of landowners' interests when cooperation between industry and local residents is necessary.	The quality of communication often varies from company to company. There is a lack of understanding between industry and those who have farming operations. Biggest concerns are with the seismic industry and the garbage they leave behind. Some residents have experienced broken promises and omissions on the part of companies. Turnover of leases from company to company makes it difficult to establish continuity and a good working relationship. Want more accountability from the top-down in companies. Companies should be responsible for the installation of gates and for drilling new water wells if appropriate.	Public consultation requires information, explanation, time and the opportunity to ask questions.	Lack of consistency between company contracts – residents would like to see standardized agreements for pipeline right-of-way and surface lease contracts. Companies' contacts change too frequently. Companies need to take responsibility for their subcontractors. The level of communication and cooperation among residents and industry has improved over the years.	The experience of dealing with the industry depend on the company and the individual. The company response time depends on whom you talk to, e.g., the plant foreman vs. the landman. Individual comments: "The company in our area is reasonably good, however, there are concerns about garbage and fast-moving traffic" and "The company responded fairly quickly and installed an incinerator when we complained about a smell". One individual experience involved a processing plant where the company had used a new technology to reduce emissions to 0%, but used a chemical for the process which produced a strong smell. The issue took years to resolve, leaving the resident frustrated with the company.	The working relationship with industry is very poor. Differences in communication style are a continual source of frustration. The Stoney Band would like industry to respond to its concerns as quickly as to the concerns of non-natives. They believe air and water quality problems are attended to much more quickly on lands adjacent to the reserve. Want industry to respect their holidays and special occasions and consult prior to undertaking maintenance work at those times.
Synergy Groups	Synergy groups and their role in facilitating continuous and effective dialog between industry representatives from companies and residents in the given area.	A commonly held view is that the formation of the Airdrie and Area Public and Petroleum Producers Awareness Alliance (APPA) has been useful for Rocky View residents. APPA has assisted with the education of residents, the creation of best practice guidelines and increased participation in the resolution of issues from both industry and the community. Other resident groups such as Residents for Responsible Energy Development and the Calgary North H_2S Action Committee have been formed to deal with specific applications or focus on particular issues.	The Quirk Creek Gas Processing Community Committee operates in the Millarville area. This is an initiative headed by Imperial Oil. At this time, the committee comprises mostly industry representatives, with one community representative from the area. Additionally, the Whisky Hill Owners Alliance (WHOA) is a resident group that has participated in EUB hearings regarding activity in their area.	SPOG has been in operation since 1992 and has played a significant role in reducing the tension between community and industry in this area. SPOG members receive training in conflict resolution skills and apply these when dealing with contentious issues. SPOG holds monthly meetings to promote continual education of its membership in issues concerning the community.	No formal groups exist in Saddle Hills, but residents gather to deal with issues on an ad hoc basis.	No groups exist in the Stoney First Nation but the Band does have an Oil and Gas Committee.
Relationship with the EUB	Comments regarding the EUB's effectiveness as a liaison between industry and residents and as an enforcer of regulations.	Not mentioned.	Concern about the EUB being too supportive of industry and not shutting in operations where problems have occurred until they can be sorted out. Concern that EUB or government studies do not result in change. One resident mentioned lack of empathy on the part of some EUB field staff: "if you don't like it here, you could just move". Other residents were impressed with EUB staff when they have contacted the EUB with questions or concerns.	Not mentioned.	One individual's experience with the EUB left them frustrated when, in their view, the EUB did not pursue a problem early enough or comprehensively enough.	Want to be directly involved with industry/EUB committees. They feel their considerable experience with the oil and gas industry would allow them to make a significant contribution. Pleased with the first steps taken by the EUB to consult with First Nations and with the hiring of First Nations people by the EUB to deal with First Nations issues. Frustrated by the lack of coordination between the EUB and by Indian Oil and Gas, the two regulators of oil and gas activity on First Nations lands.

Appendix 5. Interview Results

Nature of Concern	Issue Description	Communities Interviewed				
		Rocky View	Foothills	Clearwater County	Saddle Hills County	Stoney First Nation
Social and Other Community Effects						
General Comments	Impacts of the sour gas industry on the social fabric of a community	No social impacts have been observed to date; nevertheless, concerns exist regarding the effect of the industry on the security and cohesiveness of the community	Not mentioned	Shift from the agricultural industry to the oil and gas industry (including the sour gas industry) has resulted in a loss of the farming way of life and a change in community dynamics. A manifestation of this change is the struggle facing small communities to support the continued operation of community halls, long considered the focal point of a community	Not mentioned	Not mentioned
Change in Population Base	Changes or effects in terms of the relative size of employment by the industry within the community	Not mentioned	Not mentioned	Residents of large urban areas have purchased property in the area with the intention of living there while working in the city or working in other nonfarming industries in the area Industry has resulted in drawing people to the communities	Outflow of young people reduced and in this way the industry has made a contribution to maintaining the local population	Not mentioned
Transient Workers	Impacts of a transient workforce on the community	Not mentioned	Not mentioned	Concern was expressed that transient workers (mostly young people with no ties to the community) may have a negative effect on community dynamics Transient workers help to maintain high occupancy rates in local motels and restaurants – it was noted that the town of Sundre now has seven active lounges	Not mentioned	Not mentioned
Municipal and Community Effects	The general financial effects of the sour gas industry on local communities	Increased activity for some local businesses and cash inflow for some residents Increased wear and tear on local roads Vegetation loss The cost of emergency response equipment Operators should use more local contractors	Some employment opportunities have been created (oilfield services)	The industry has contributed significantly to job creation in the area The industry has created supplementary income for those in the agricultural sector The industry has improved the economic diversification of the county, yet some residents and members of SPOG would like further diversification so the county is not dependent on the energy sector Improved infrastructure in the form of increased reliability of power supply and more road construction	The industry has created additional job opportunities for those already in the area (in the agricultural sector mostly) and kept many younger people in the community	Virtually no employment benefits have been seen in the Stoney Band community (with unemployment at 80%) and financial contributions (to sports teams and the like) have been minimal Increased use of reserve infrastructure (roads) by companies without any financial compensation